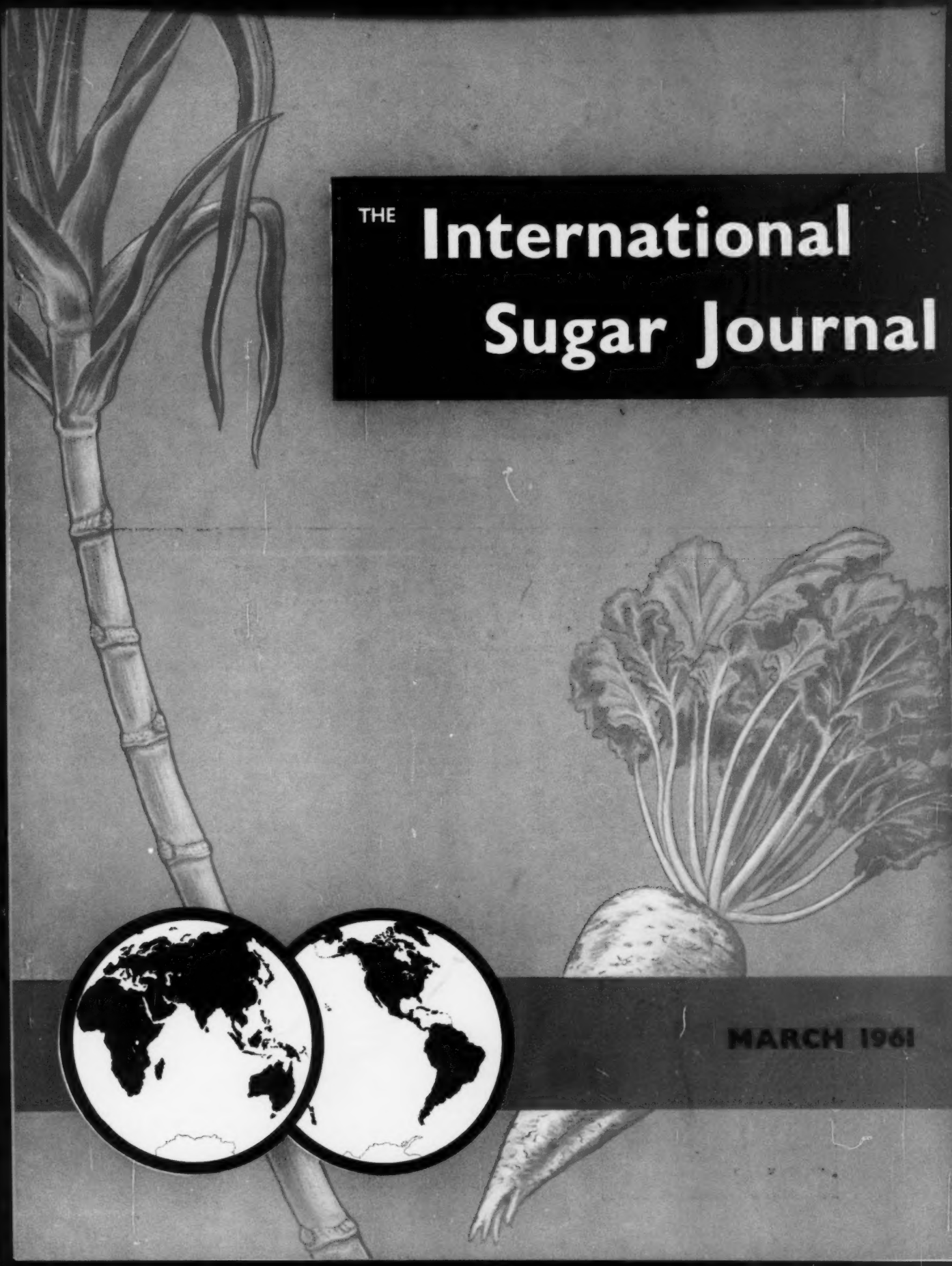

THE International Sugar Journal

MARCH 1961

cane carrier and intermediate carrier

SLATS

Mirrlees Slats combine strength with minimum weight.

CANE CARRIER SLATS

Can be supplied, double or triple corrugated, black or galvanised, and will suit any 6 in. pitch chain and 8 in. pitch chains in the larger sizes. Where dimensions are given, slats can be supplied holed for bolts or rivets.

INTERMEDIATE CARRIER SLATS

Manufactured in designs to suit the 900 and the 5,000 series of Inter Carrier Chains. The overlap is close and slats can be supplied Black or Galvanised and holed for fixing if desired.

CHAIN & SPROCKET WHEELS

Mirrlees have exceptional experience in supplying cane and intermediate carrier chains for Sugar Mills. Full information on request.

Write for our Chains & Slats Brochure S131 – 58

'Mirrlees'

THE MIRRLEES WATSON COMPANY LIMITED

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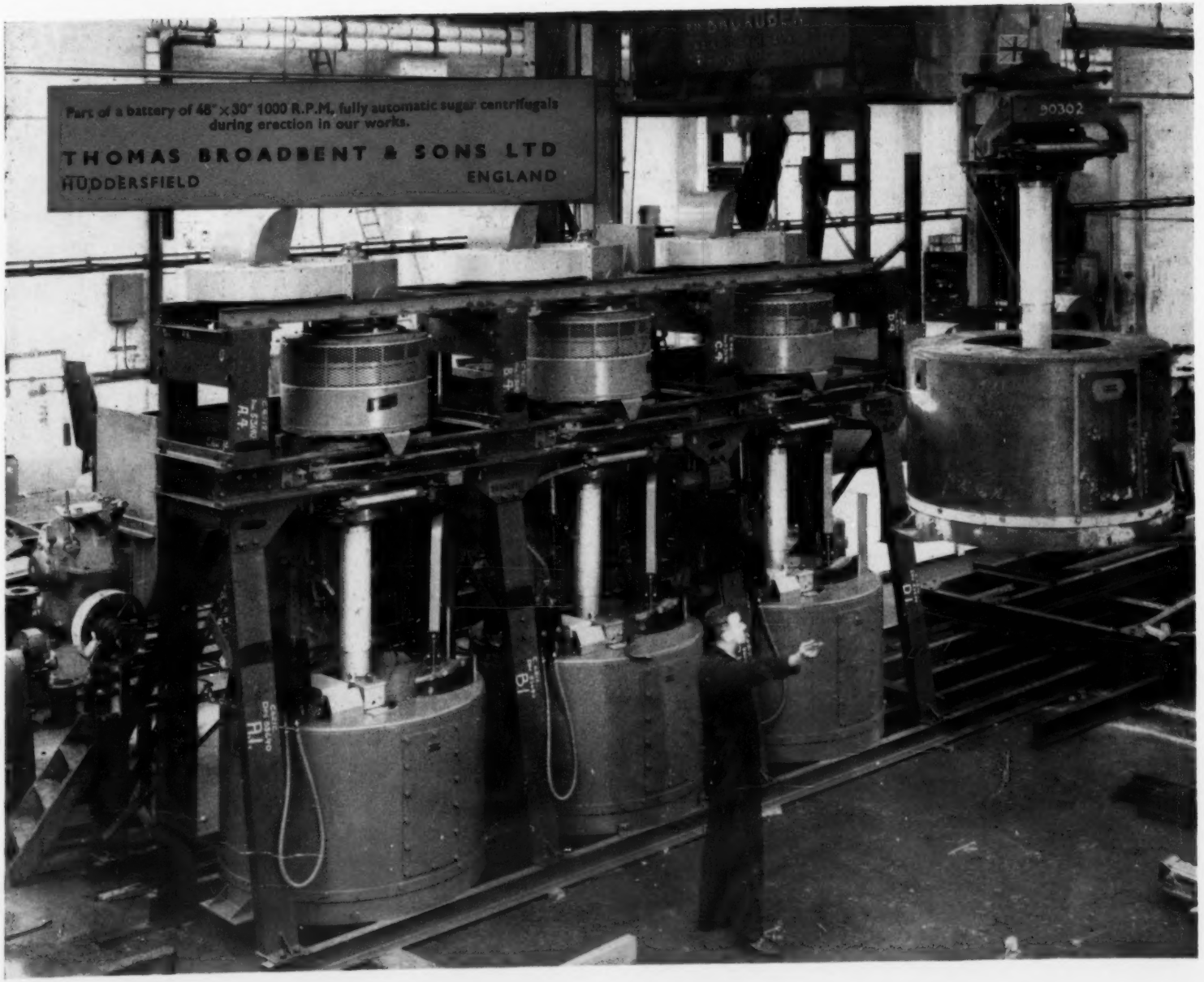
Part of a battery of 48" × 30" 1000 R.P.M. fully automatic sugar centrifugals during erection in our works.
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THE B & M SINGLE STAGE
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Simple in design
Reliable and Economical
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25 to 1,200 h.p. direct coupled at speeds of up to 5,000 r.p.m. max. or supplied with reduction gearing of any desired ratio.

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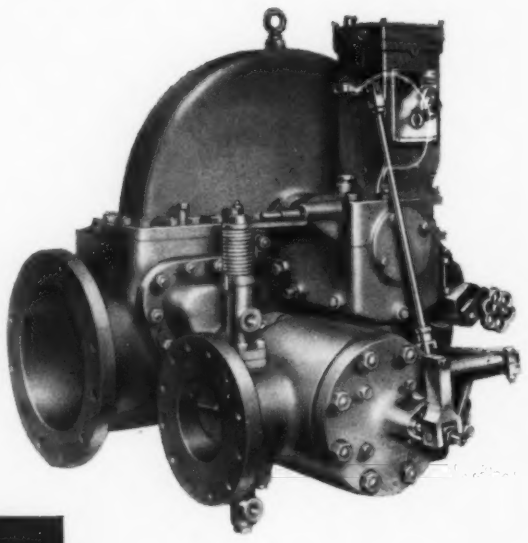

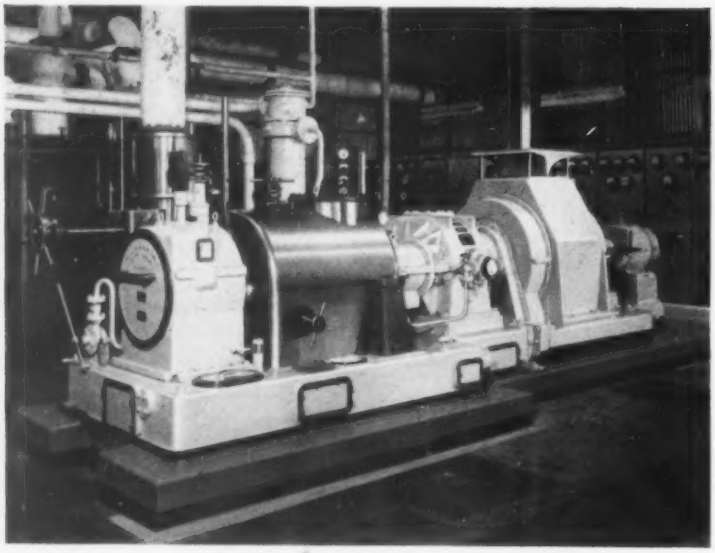

750 kw back pressure turbine installed at Farleigh Sugar Mill, Queensland.

1,500 kw 'B & M' back pressure turbine and several steam engines also installed.

Many hundreds of 'B & M' Steam Turbines and Steam Engines have been supplied to the Sugar Industry for electrical and mechanical drives for:

CRUSHERS
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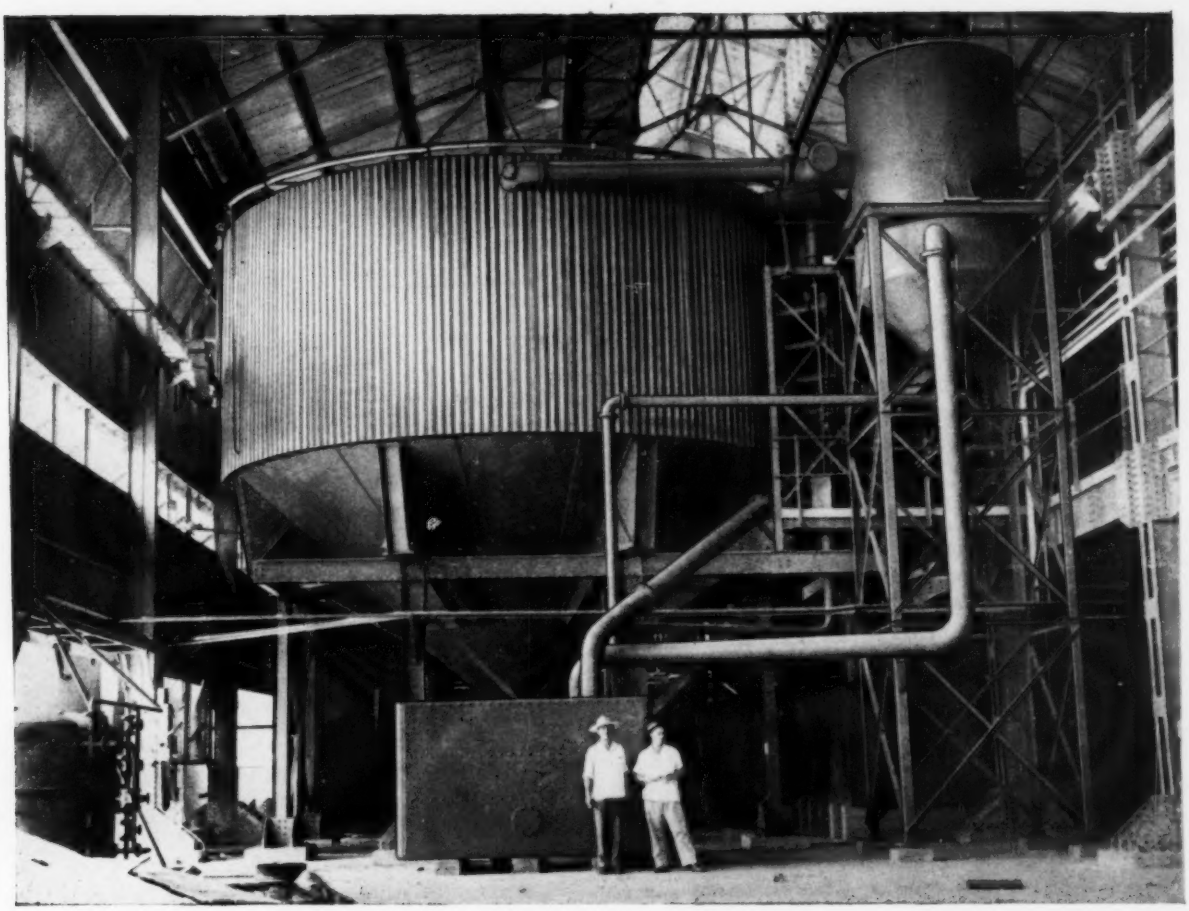

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Illustrated is one of our most recent installations, a 30 feet, 5 tray Subsider in operation in Venezuela.

This Subsider enables juice to be drawn off at 5 points of optimum clarity. Surface evaporation is obviated, no surface scum enters the tank, and a high temperature is maintained throughout the apparatus.

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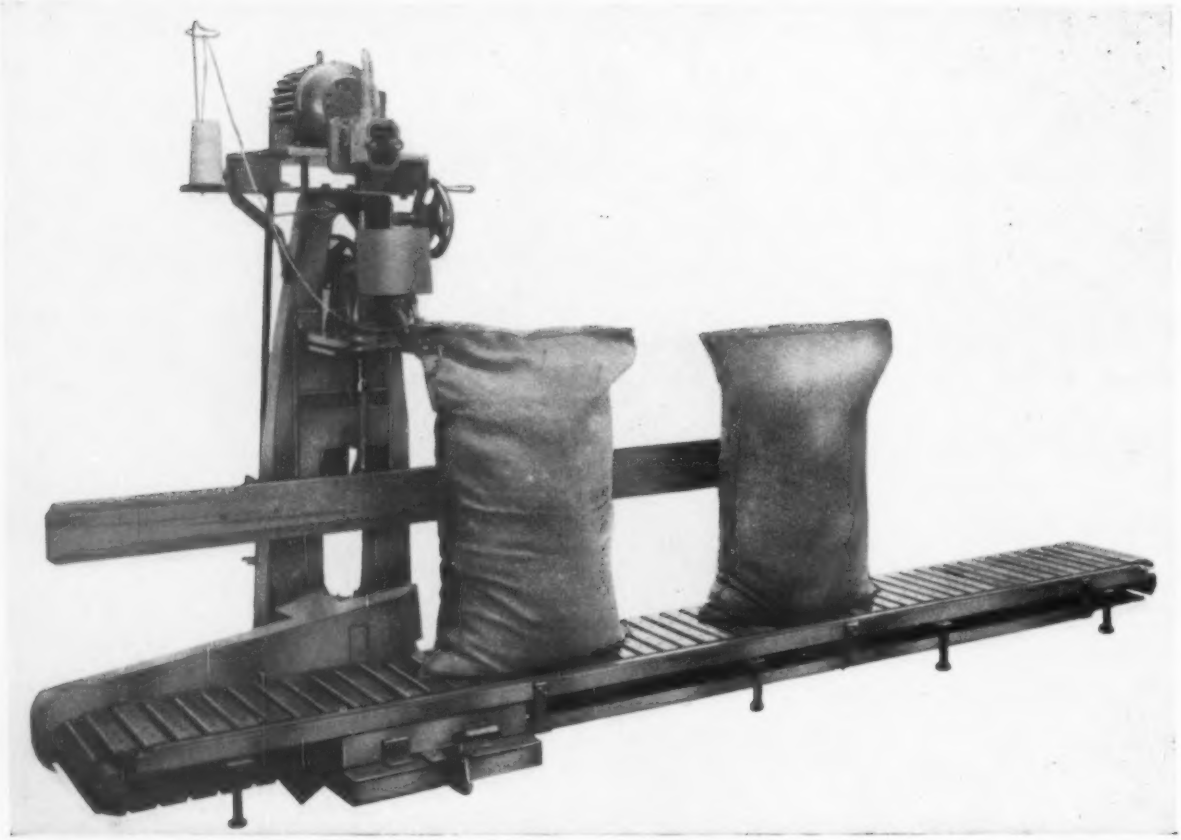
The 'Super' Universal Sack Closing Machine

MODEL NO. 5B

Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive



This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.

Machines can be seen working by appointment.

Power required 2 *h.p.* *Shipping weight :* 14 *cwts.*

Manufactured in Great Britain by :

The Sack Filling & Sewing Machine Syndicate Limited

(Timewell's Patent)

TIMEWELL WORKS · LOCKFIELD AVENUE · BRIMSDOWN · ENFIELD . MIDDX.

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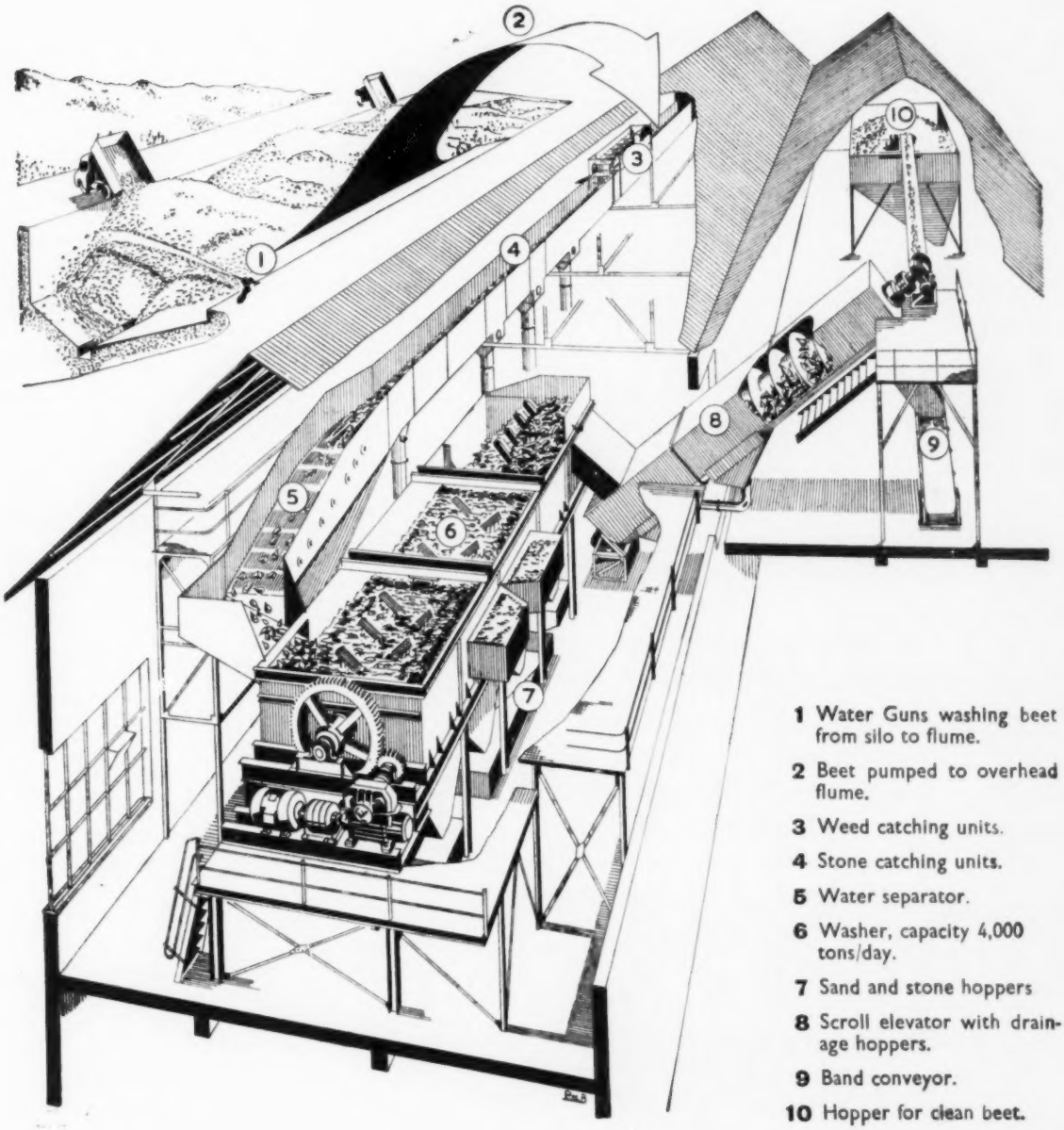
BEET WASHING PLANT

AS SUPPLIED TO THE BRITISH SUGAR CORPORATION LTD



1 Water Guns washing beet from silo to flume.

2 Beet pumped to overhead flume.

3 Weed catching units.

4 Stone catching units.

5 Water separator.

6 Washer, capacity 4,000 tons/day.

7 Sand and stone hoppers

8 Scroll elevator with drainage hoppers.

9 Band conveyor.

10 Hopper for clean beet.

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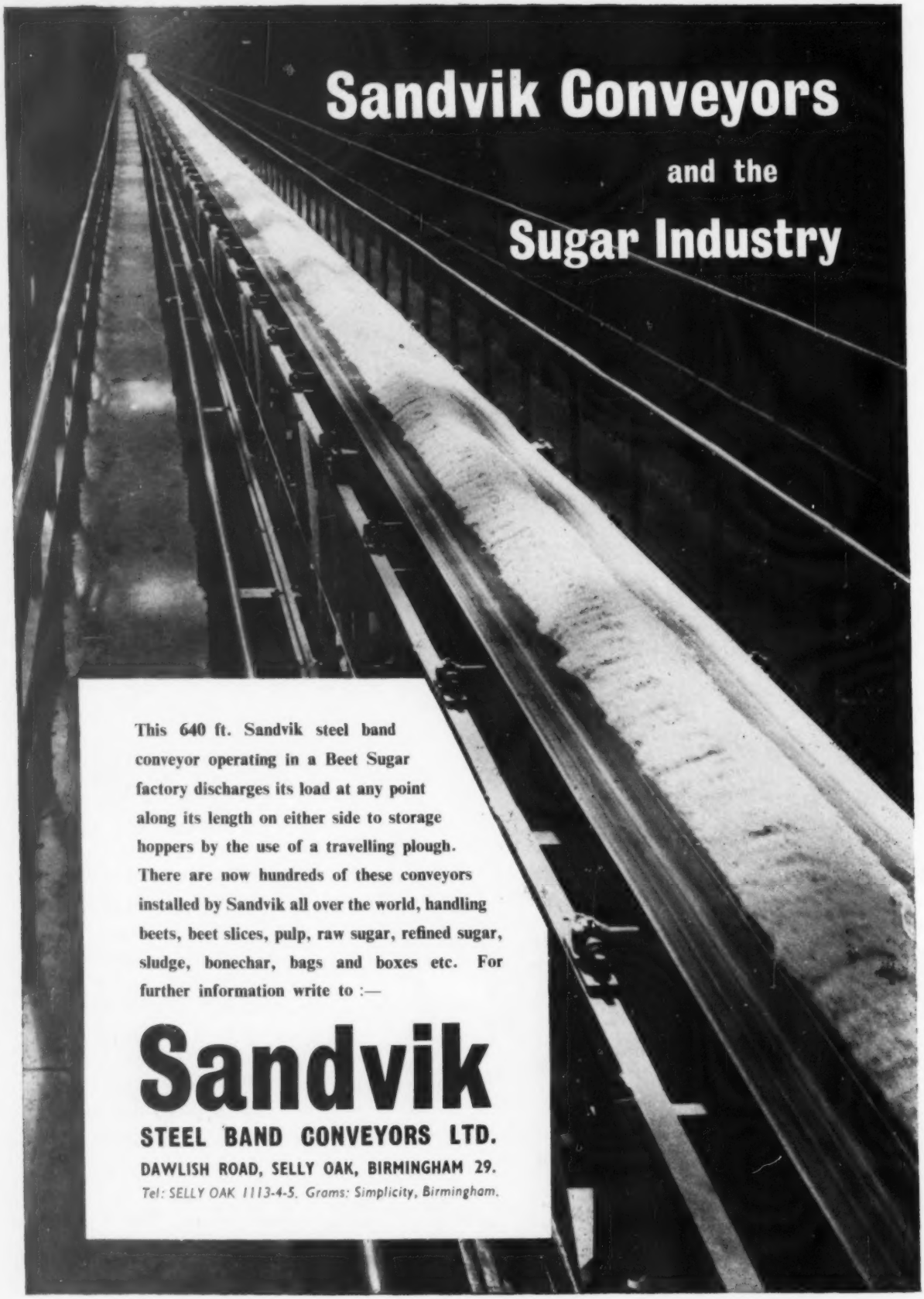


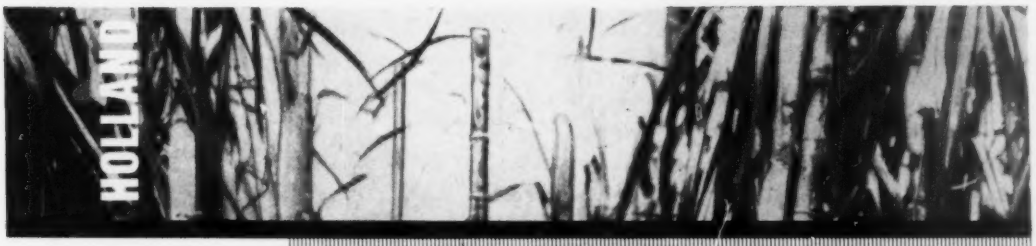
This 640 ft. Sandvik steel band conveyor operating in a Beet Sugar factory discharges its load at any point along its length on either side to storage hoppers by the use of a travelling plough. There are now hundreds of these conveyors installed by Sandvik all over the world, handling beets, beet slices, pulp, raw sugar, refined sugar, sludge, bonechar, bags and boxes etc. For further information write to :—

Sandvik

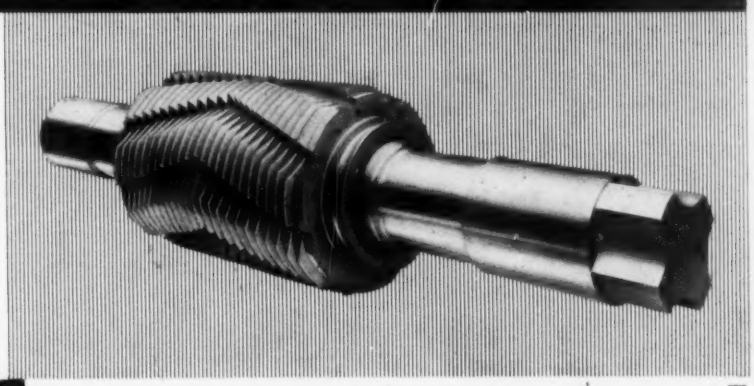
STEEL BAND CONVEYORS LTD.

DAWLISH ROAD, SELLY OAK, BIRMINGHAM 29.

Tel: SELLY OAK 1113-4-5. Grams: Simplicity, Birmingham.



One manufacturer for your complete sugar factory:



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MILLING PLANT:

Mill rollers with coarse grained cast iron shell, rough surface, high quality steel shaft.

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Roller casings

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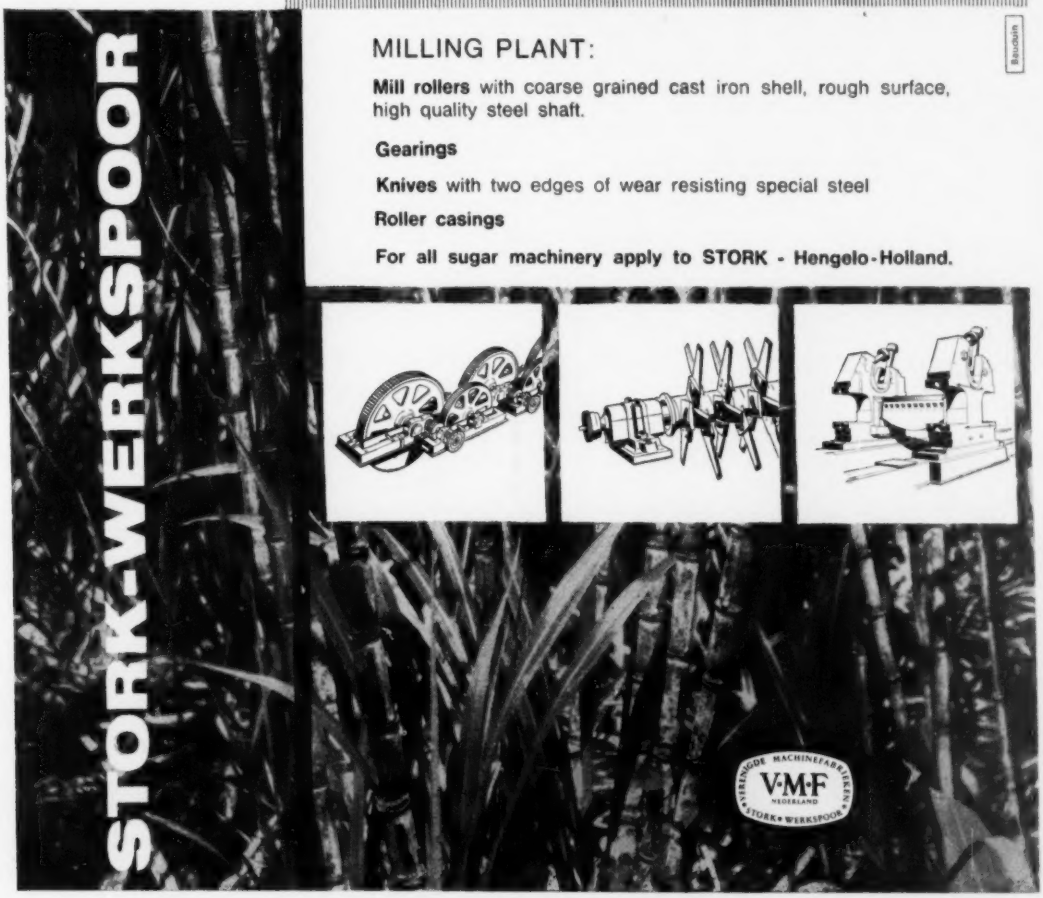
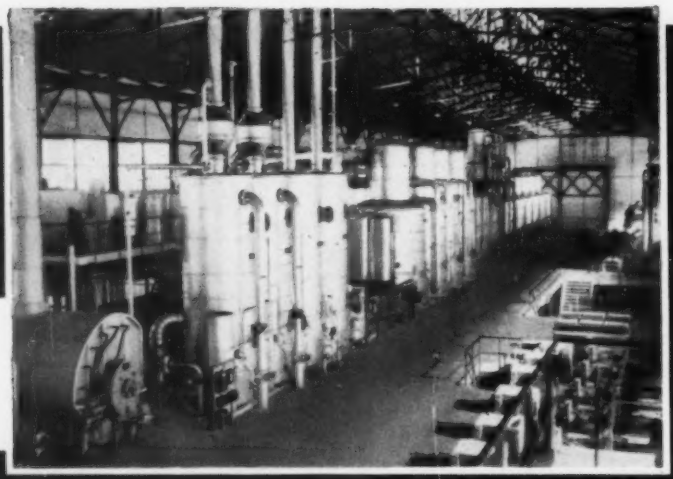


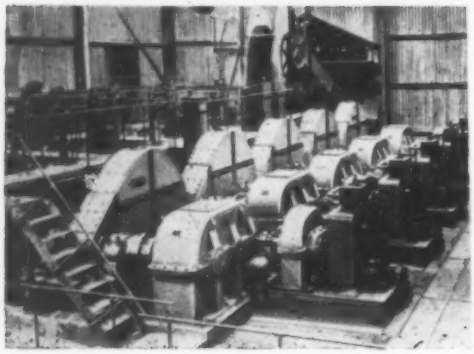


WE

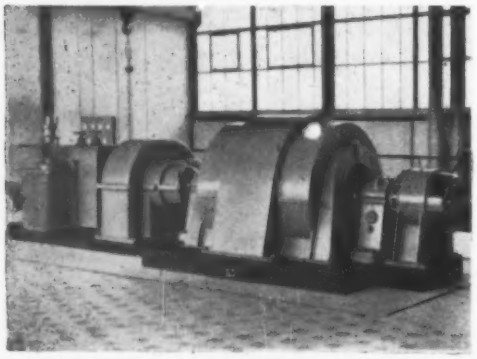
can supply everything for your cane or beet

SUGAR FACTORY

Set of five 26" x 36" mills.
Urena sugar factory (Venezuela)



1800 kW turbo-alternator.
Malatya sugar factory (Turkey)



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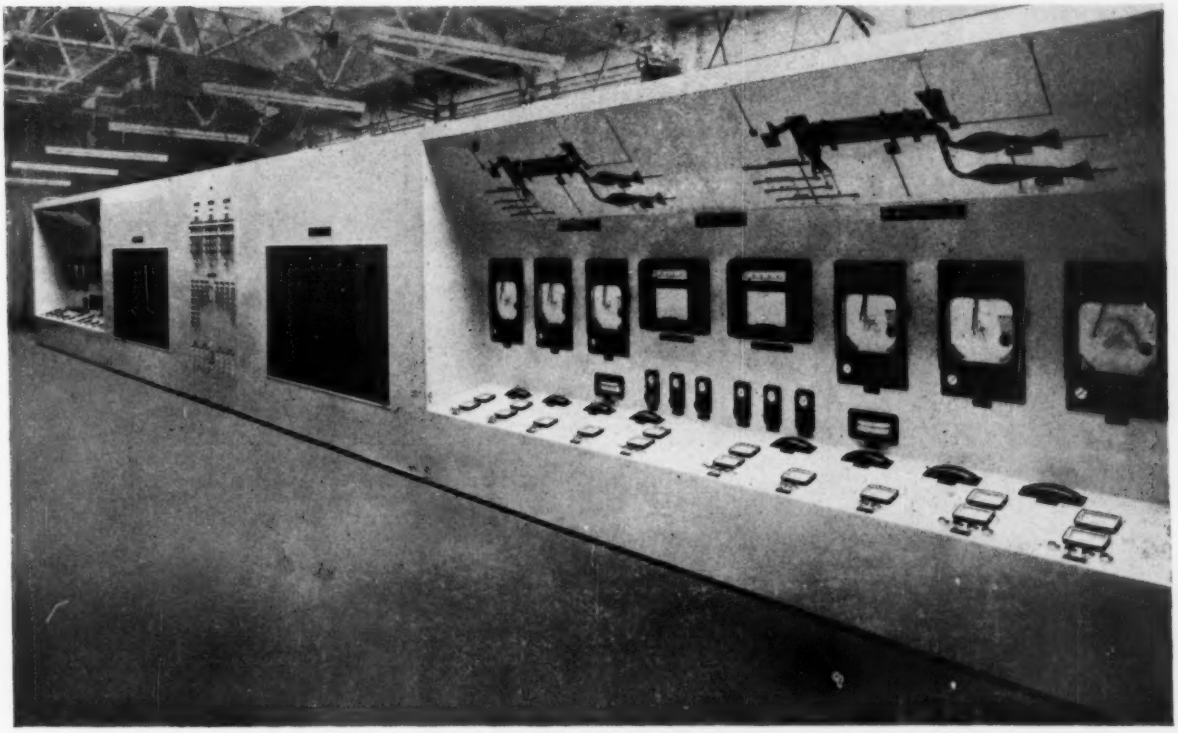
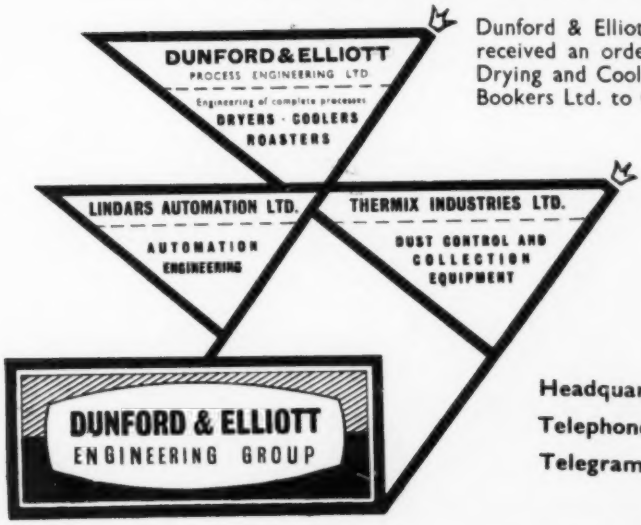
Choose ROTARY LOUVRE

One of Dunford & Elliott's latest and largest achievements for sugar refineries is the installation of four completely automatic Rotary Louvre Dryers and ancillary equipment at the THAMES REFINERY of TATE & LYLE LTD.—believed to be the biggest refinery in the world.



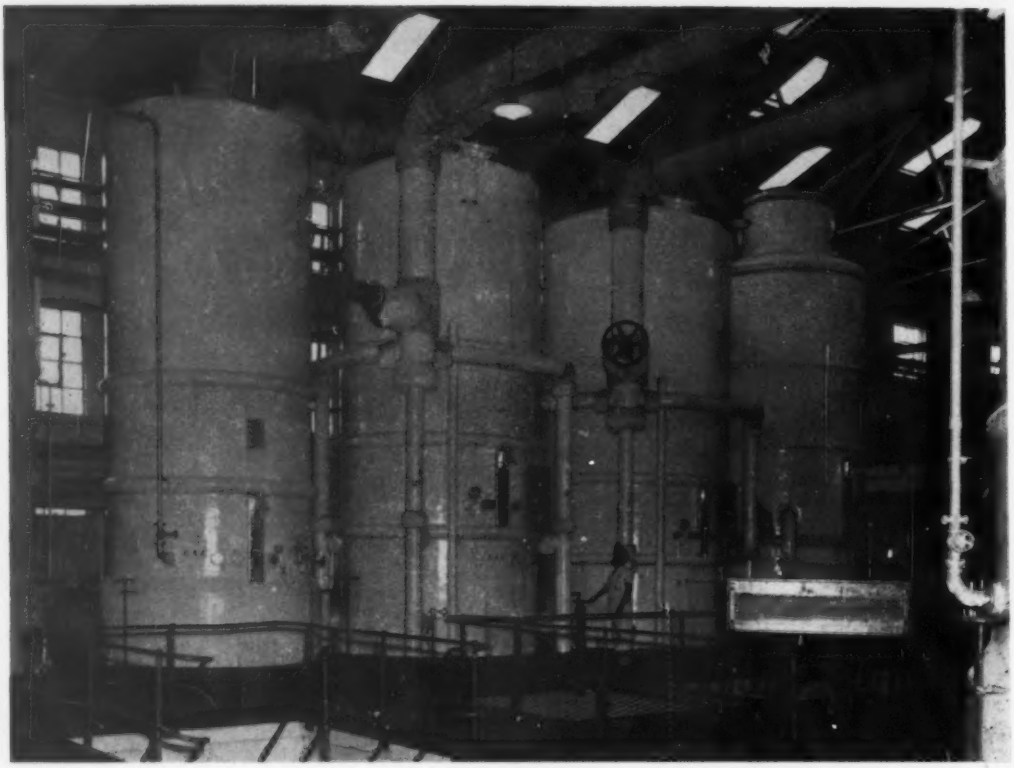
Control panel for Rotary Louvre sugar drying installation at the new Tate & Lyle Thames Refinery, designed and supplied by Dunford & Elliott. Photo by courtesy of Tate & Lyle Ltd.



Dunford & Elliott are also proud to announce having received an order to supply *Rotary Louvre* Sugar Drying and Cooling installations through Messrs. Vickers & Bookers Ltd. to two factories in the U.S.S.R.

Rotary Louvre Dryers and Coolers are used in leading industries throughout the world—as well as in the sugar industry—and frequently form part of such giant industrial projects as *Durgapur* in India.

Headquarters: 143 Maple Road, Surbiton, Surrey
Telephone: Kingston 7799
Telegrams: Lindaresco, Telex, London.



Evaporators at the British Sugar Corporation Beet Sugar Factory at Cupar fitted with H & W 70/30 Brass Tubes. The evaporators are lagged with plastic lagging. (Photograph by courtesy of the British Sugar Corporation Limited).

H&W

BRASS TUBES

for

JUICE HEATERS

EVAPORATORS

VACUUM PANS

for quality uniformity and dependability

HUDSON & WRIGHT LTD. HALBERTON STREET, BIRMINGHAM 18

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Since it was established in 1890, our Company has manufactured machinery for the sugar industry, and for more than forty years has specialized in constructing centrifugals.

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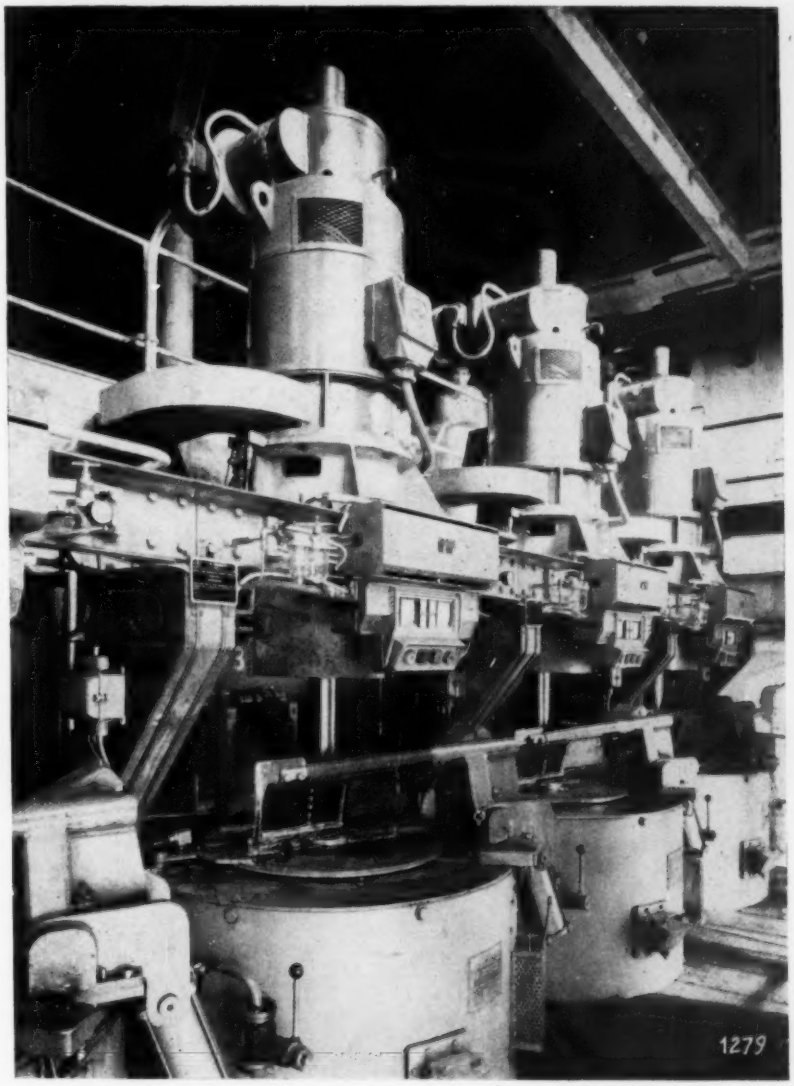

FULLY AUTOMATIC SUGAR CENTRIFUGALS

Type	*Basket D × H*	*Basket cross section*	*Massecuite Max. Charge*	*Performances*		
				Mod.	*Max. sp. r.p.m.*	*Cycles per hr.*
"SCARA. U"	1250 × 830 mm.	Cylindrical with truncated cone shaped bottom	500 kg.	Normal	1000	30
				Velox	1500	25
"SCAME. P"	1050 × 585 mm.	Cylindrical with flat bottom	350 kg	Normal	1500	20
				Velox	1800	10
"SCAME. G"	1220 × 762 mm.	Cylindrical with flat bottom	650 kg.	Normal	1000	25
				Velox	1500	20

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TERNI **ITALY**

Progressive Sugar Factories in –

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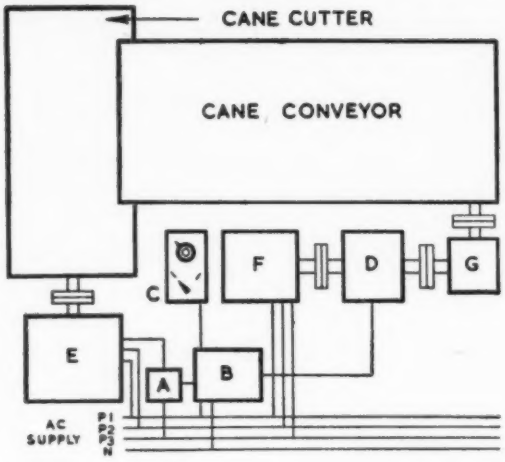
ARE INCREASING THEIR PRODUCTION BY USING

HEENAN-DYNAMATIC COUPLINGS

IN THE DRIVES TO CANE FEEDER CONVEYORS

Automatic regulation of feed ensures that cane knives are always working at peak efficiency thus achieving maximum throughput

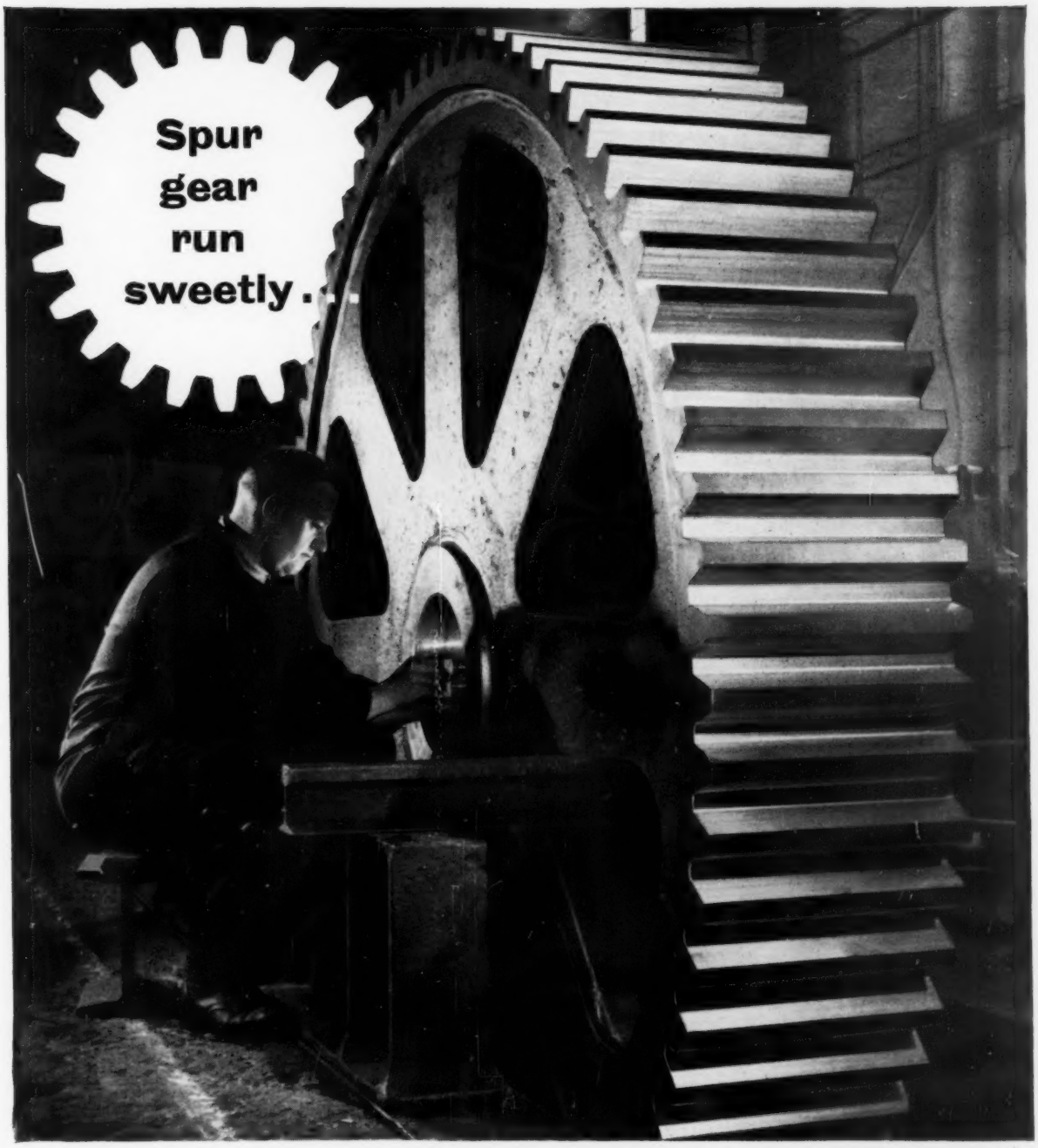
Please send for details



KEY TO DIAGRAM

- **A** Current transformer
- **B** Electronic excitation unit
- **C** Manual control of conveyor speed
- **D** HEENAN-DYNAMATIC COUPLING in conveyor drive
- **E** Cutter motor
- **F** Conveyor motor
- **G** Gearbox

HEENAN & FROUDE LTD., ENGINEERS, WORCESTER, ENGLAND



And—puns apart!—it undoubtedly will do, for it's made by David Brown. This particular spur gear is for a sugar mill, and has 132 teeth, is 24 inches face width, and 1 D.P. Of course, David Brown can make them a lot bigger than that! The checking of the keyway is just one of the tests made at many stages in the production of David Brown gears. That's one of the reasons why they run so sweetly, so long!

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JACKSON DIVISION · SALFORD WORKS · HAMPSON STREET · MANCHESTER 5 Telephone: Blackfriars 3577 (4 lines)

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Electrical Plant Division, Stafford
WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

15.40

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The illustration shows a Spencer 42″ troughed belt conveyor built for the Love Lane Refinery of Tate & Lyle Limited. Tate & Lyle also chose Spencer Sugar handling equipment for their new 100,000 ton silo at Huskisson Dock, Liverpool.

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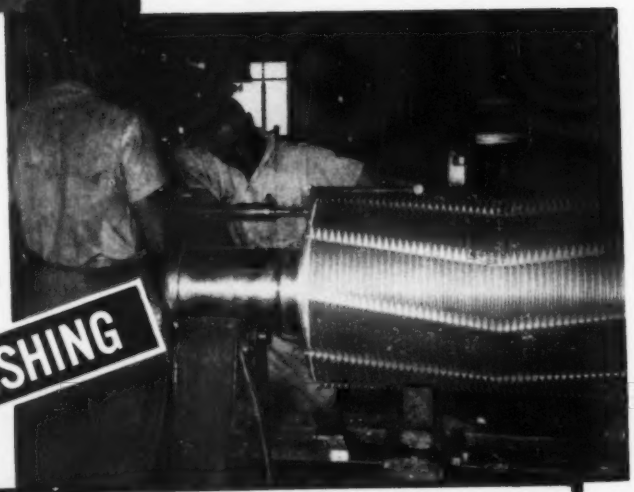
and read facts about

K.I.W SUGAR ROLLERS

MOULDING

GROOVING



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KINGSTON INDUSTRIAL WORKS Mill Rollers have been supplied in ever increasing quantities to the Jamaican sugar industry for over half a century.

During 1960 almost one hundred rollers were supplied to all of the Island's leading sugar factories. Exports of rollers during the year were to British Guiana, St. Kitts and Trinidad. In 1961 we are planning for an even greater production. With every facility for casting and machining a wide range from 36 in. to 84 in. mill rollers, this company is proud of its long standing reputation for uniform open grain roller castings from special hard, wear-resisting iron.

All Jamaican factories are now operating their mills with K.I.W. rollers, bearings, trash plates and scrapers, an indication of their satisfaction and confidence in the products of Kingston Industrial Works Ltd.

K.I.W. Manufacture and Re-shell rollers under Expert Supervision.
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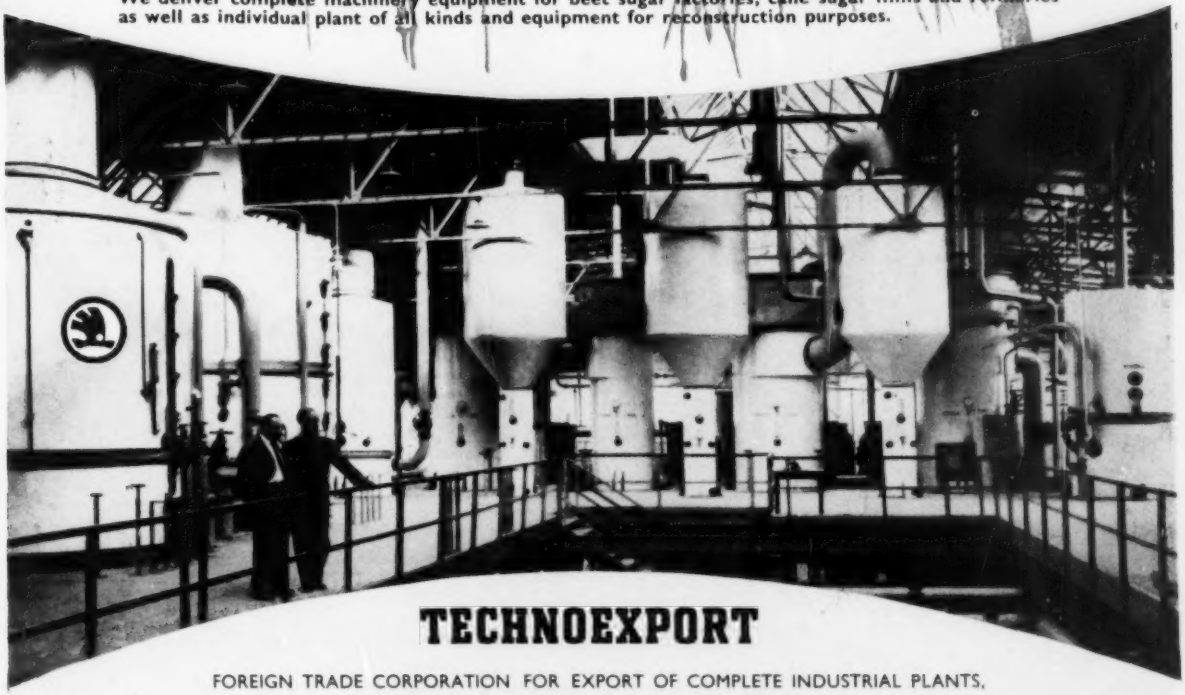

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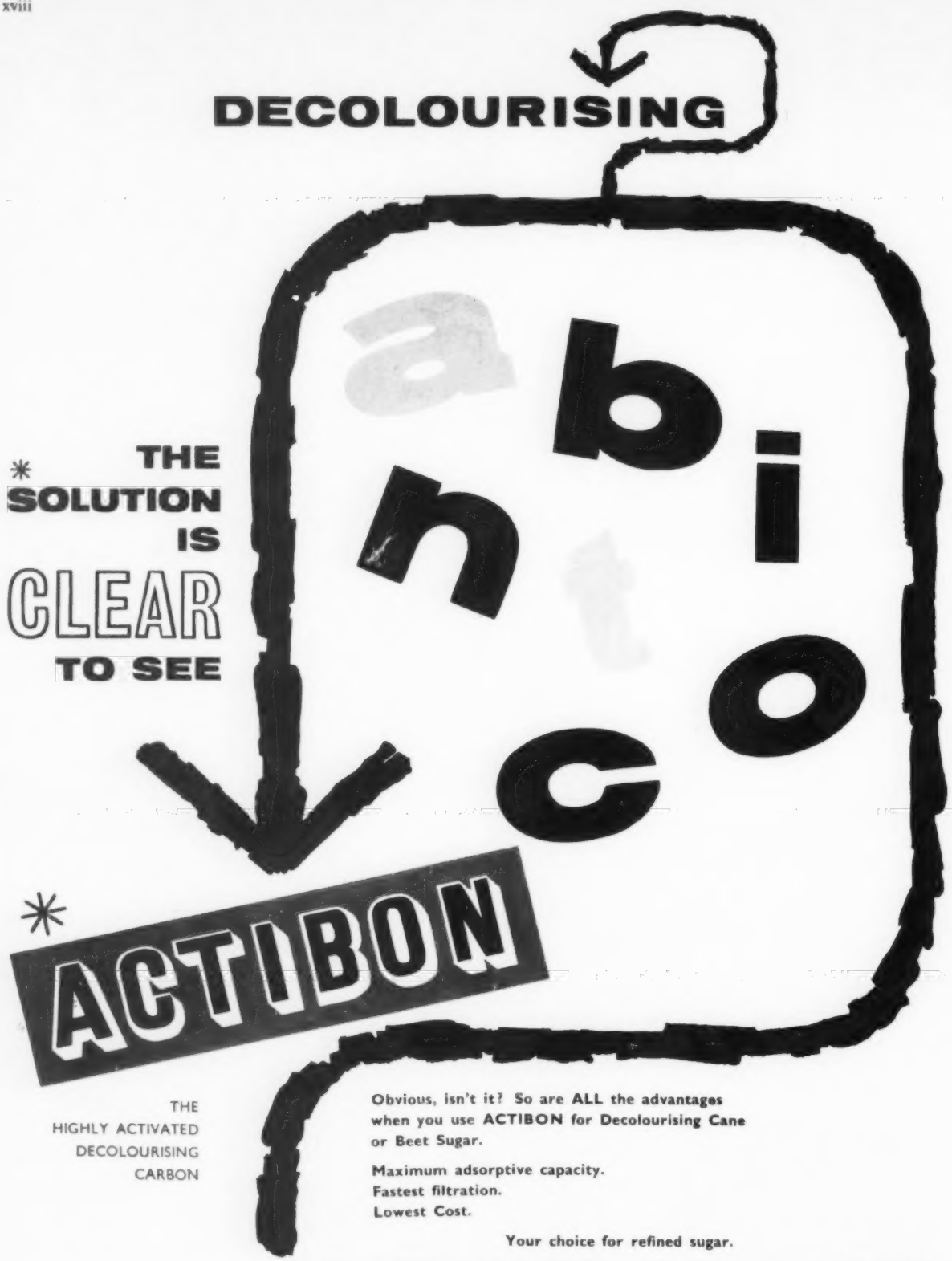

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ENTRAINMENT SEPARATORS

Low Pressure Loss

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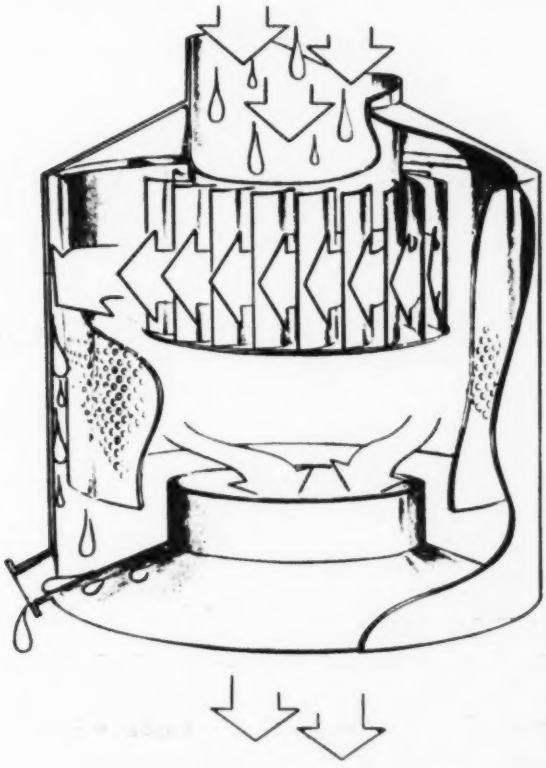

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The HONIRON separator is standard equipment on all HONIRON pans and evaporators and it may be adapted easily to existing evaporating apparatus. Hundreds have been installed in pipes ranging from 8 in. to 60 in. in diameter. Write for bulletin S-2!

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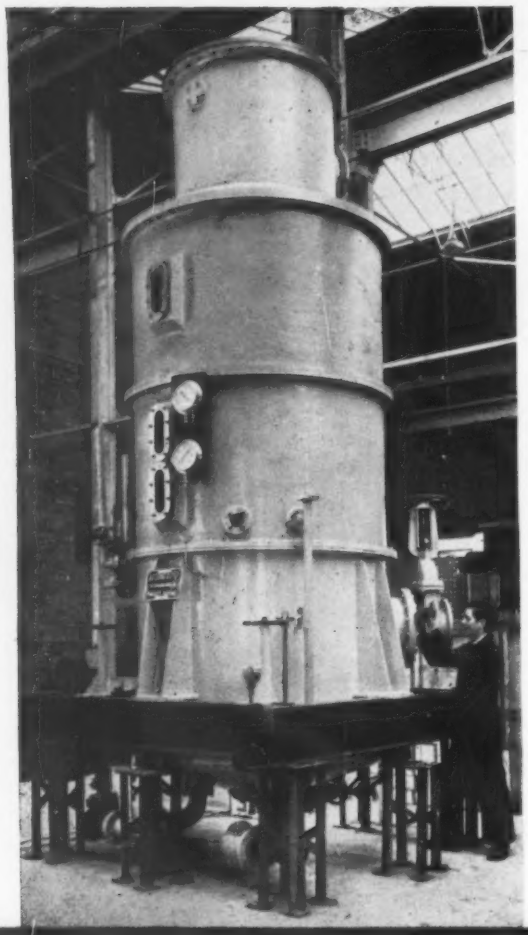
CABLE: HONIRON NEW YORK



Evaporators by

*CRAIG

*** manufacturers of machinery for Complete Sugar Factories**

This illustration shows a sugar factory in India. The complete mechanical equipment for this factory was supplied by Craig.

Your enquiries will have our prompt attention.

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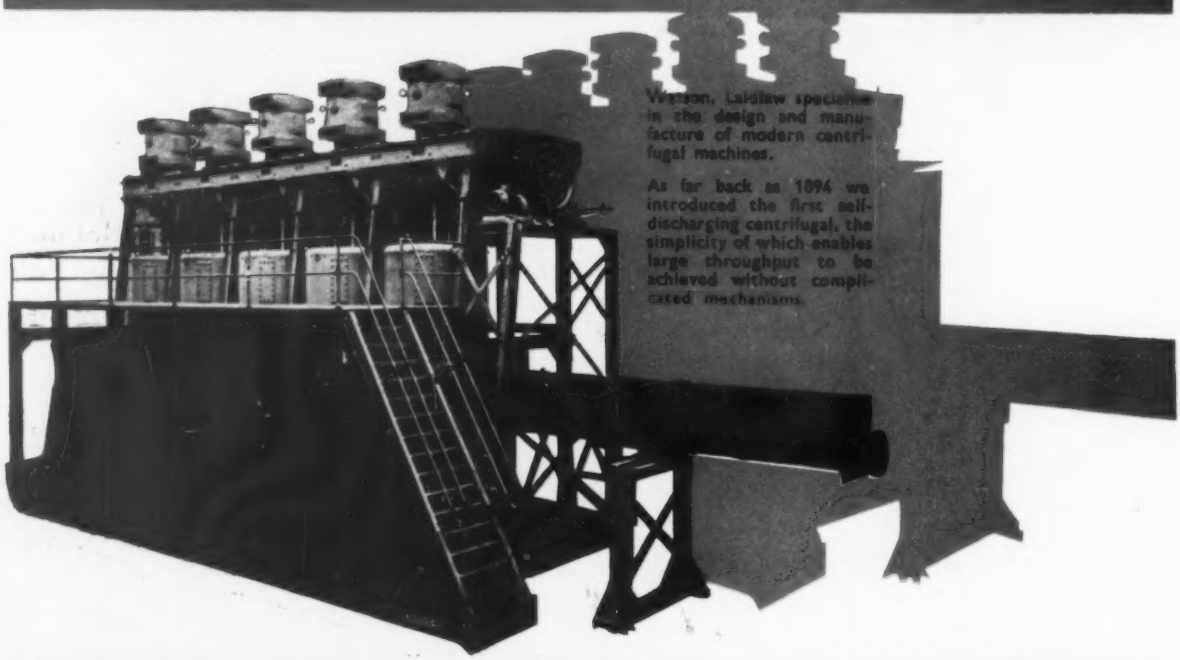
Self discharging centrifugals



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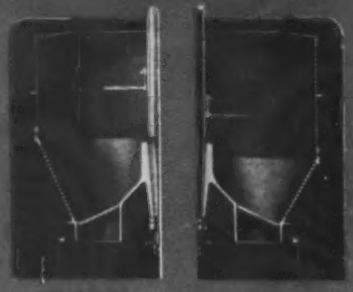

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THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXIII MARCH, 1961 No. 747

NOTES AND COMMENTS

New U.S. sugar legislation[1].

Proposed legislation has been introduced by Representative HAROLD D. COOLEY, Chairman of the House Agricultural Committee, for the extension of the U.S. Sugar Act until 31st December 1962. The legislation contains provision for authority for President KENNEDY to cut Cuba's normal share of the U.S. market, but makes no provision for similar cuts in the Dominican Republic quota which had been requested by ex-President EISENHOWER. The present Sugar Act terminates on the 31st March 1961 unless it is extended.

Mr. COOLEY said that while his first plan had been to extend the Act only to the end of 1961, the extension through 1962 was necessary because of the unsettled conditions in certain normal foreign supplies.

* * *

International Sugar Agreement price criterion.

At the meeting of the International Sugar Council due to be held on the 20th February, a development which will have been under discussion is the price criterion of the International Sugar Agreement. With the termination of the New York No. 4 contract, the price basis used previously has gone and it seems likely that the Council will be faced with a choice either of the new No. 8 Contract price of the New York Exchange, the London Terminal Market Daily price or some compromise between the two.

B. W. Dyer & Co., the New York sugar economists and brokers, consider the first to be best suited to serve as a criterion. It is "quoted f.o.b. and stowed on receiver's vessel, and permits delivering of sugar of at least 12 different origins. The London futures Contract is quoted c.i.f. London and only permits delivery of 'preferential' sugar produced in a country which has signed the Commonwealth Sugar Agreement.

"The London Exchange obviously recognizes the limitations of its contracts, and also bases its spot price on transactions with other destinations. Thus, it would be impossible to effect a perfect (deliverable) hedge of non-preferential sugar on the London Exchange against its own spot price.

"The potential tonnage of actual sugars which could be delivered against the No. 8 Contract is around 2 million tons per year, after excluding possible diversions to the U.S. and Commonwealth markets because of price premiums. However, the tonnage of sugar which can be delivered in London at free world prices is less than 1 million tons annually. Consequently the yearly volume of trading in No. 8 is expected to increase and exceed that of London, which has recently benefited by No. 4 Contract uncertainties".

At the time of writing it remains to be seen what the Council will decide is most suitable for fulfilling the requirements of the Agreement.

* * *

Fiji sugar enquiry[2].

The Colonial Secretary, in a written answer to Mr. IREMONGER on 21st December 1960 said that Sir TRUSTRAM EDE had been appointed by the Governor of Fiji as Chairman of a commission of enquiry to report on the sugar industry in the islands. He would be aided by two commissioners, Mr. C. J. M. BENNETT, of Barton, Mayhew & Co., and Mr. J. S. WHEATLEY, of the Colonial Office. The commission's terms of reference were to examine and report on the organization, operation, economic position and prospects of the industry and on the advisability of establishing a statutory sugar board, and to make recommendations to ensure that (*a*) the manner in which the industry is organized, operated and developed is to the advantage of the Colony, (*b*) that relations between all those concerned in the industry are on a satisfactory basis and (*c*) that fair and equitable returns are received by the various sections of the industry, having regard to prices obtained for the sale of sugar and its by-products both locally and overseas. Mr. MACLEOD added that if the establishment of a statutory sugar board was considered advisable the commission would make recommendations as to the composition and functions of such a board.

[1] *Public Ledger*, 4th February 1961.
[2] *Commonwealth Producer*, 1961, (381), 16.

French export subsidy[1].

The French Government decided on 3rd February to grant a subsidy of 70 million new francs for the export of 500,000 tons of sugar.

Following this year's bumper beet crop in France, sugar production will greatly exceed domestic consumption. The difference between the world price and French prices is put at 50 to 55 N.F. per 100 kilos, but it was said in trade circles the Government subsidy will not be sufficient to make up the difference. The subsidy corresponds to 14 N.F. per 100 kilos and the Government wants beet producers and sugar refiners to finance the balance.

Negotiations are now expected to start with all interested branches of the industry on ways of raising the funds necessary to make French sugar competitive on world markets.

Very keen competition is expected on world markets because of the big crops in other European countries.

* * *

U.S. domestic consumption, 1960[2].

Domestic consumption of sugar during the calendar year 1960, as compiled from trade records kept by Willett & Gray Inc., inclusive of all refiners, processors and importers, showed an increase of 1·629% over 1959. According to deliveries to the trade by refiners, beet processors and importers, 1960 consumption amounted to 7,682,016 long tons of sugar, refined value basis, compared with 7,558,900 long tons during 1959, an increase of 123,116 tons. Although exports are not included, the above figures take into account all deliveries to U.S. Armed Forces both at home and abroad.

Of the total consumption figure, cane refiners supplied 5,116,954 tons against 4,965,745 tons during 1959, with beet processors accounting for 1,863,856 tons compared with 1,814,963 tons in the preceding year. The beet figure for 1960, however, includes 56,437 tons adjustment in the 1959 overall total, such figure having been used for constructive deliveries in 1959. On the basis of a population at 31st December 1960 of 183,200,000, per caput consumption in 1960 is estimated at 93·93 pounds, refined value.

* * *

Cuban sugar crop distribution[3].

At the end of January the President of Cuba signed a decree distributing the 1961 sugar crop. The breakdown is as follows: 350,000 Spanish long tons for local consumption, 1,992,187 tons for free export to the world market during 1961 and 292,969 tons compulsory reserve pursuant to the International Sugar Agreement. The balance of the production up to 4,000,000 long tons will be a part of the voluntary reserve for export to the world market. However, all mills are authorized by the same decree to grind all remaining available cane. A provisional price of 3·64 cents per Spanish pound has been established for production up to 4,000,000 tons while, on production above this amount, a provisional price of 2½ cents has been established. It is reported that official sources in Cuba estimate the outturn of the 1961 crop at 6 million long tons.

* * *

South African sugar sales expansion committee[4].

To meet the need for larger sugar sales and to conduct research into sugar uses, the South African Sugar Association has set up a Marketing and Sugar Research Committee consisting of the Chairman of the milling and growing sections, three miller members and one grower member, with the industry's Public Relations Officer as Secretary and Convenor. At the inaugural meeting Mr. W. K. BUCHANAN was elected Chairman and Mr. A. A. LLOYD, Vice-Chairman. The Sugar Association's Council has agreed to the appointment of a market research officer and a qualified technologist. Initially, they will work respectively in conjunction with the Public Relations Department and the Sugar Milling Research Institute and other research institutions in developing industrial and commercial uses for sugar. The South African Sugar Association has also applied for membership of the Sugar Research Foundation, Inc., of New York.

* * *

Sugar expansion in Iran[5].

Sugar factories at Abkooh, Terbat Herdarieh, Koraj, Shahabad, and Fassa are to be enlarged. A privately owned plant, Ahwaz Refinery, located near Ahwaz, began operation in February 1959. It has a daily capacity of 110 short tons of sugar and refines imported raw sugar. The Fariman Sugar Mill near Meshed with a capacity to handle 1100 tons of beets daily began slicing beets during the early months of 1960. Planned to begin operation during the 1960/61 year are the Garmsar Refinery near Tehran, with a daily capacity of 83 short tons of sugar, and the following plants each having a daily slicing capacity of 1100 to 1700 short tons: Bigan Refinery near Shirvan, Ghochan Mill in Khorasan, Fars Sugar factory near Shiraz, and the Isfahan Sugar Mill near Isfahan.

Plans to develop production of cane sugar in Iran finally reached the action stage with the awarding on 21st May 1959, of a contract for a mill and refinery. The refinery is scheduled to be completed by 1st May 1961, and the mill is to be completed and ready for operation in October 1961. The Khuzestan Development Service expects to start production of cane sugar in the autumn of 1961. The ultimate goal is an annual output of 33,000 short tons of sugar. An application for a loan of $12·8 million ($8·5 million in foreign exchange and the balance in local currency) was made in August 1960 in order to cover the remaining cost of the Khuzestan project.

[1] *Public Ledger*, 4th February 1961.
[2] *Willett & Gray*, 1961, **85**, 32-33.
[3] *Lamborn*, 1961, **39**, 20.
[4] *Commonwealth Producer*, 1961, (381), 33.
[5] *Willett & Gray*, 1961, **85**, 8.

THE SUGAR CANE AND ITS MOISTURE RELATIONS

SUGAR cane is grown under so wide a diversity of climatic conditions that it is difficult, if not impossible, to generalize on any of its cultural aspects. Nevertheless it is possible to make two statements which bear a close approximation to the truth. The first is that, when temperature is not the limiting factor, in particular as during the "grand saison", humidity is the dominant climatic factor in determining the magnitude and quality of the crop; the second, that the water requirement varies with the age of the plant. These generalizations are probably true, to a greater or lesser extent, of most perennial crop plants but it is difficult to think of any other crop plant that shows these phenomena more clearly. The check to growth that occurs when a drought interrupts the main growing season is too obvious to be overlooked, and the ill-effects of excessive rain during the period of maturation discloses itself all too unpleasantly when the crop comes to the mill. About the latter, man is impotent, for it is a question of air humidity as well as rainfall and over these he has little control; but he has various means of making good, both culturally and, even more important, by irrigation, a deficiency in rainfall. Irrigation is expensive, whether by flow or overhead and, where it is adopted, financial considerations make it additionally important to see that an unnecessary supply is not given even when, from the aspect of plant growth, it is hardly possible to supply too much.

It is the above considerations that justify the considerable efforts made to find a ready means of determining when the moisture content of the soil has reached that low level at which growth is checked. It is, unfortunately, a point which defies optical determination for it lies somewhere above the wilting point and below field capacity. Two lines of approach have been made to find a solution to the problem. The first is to secure a means of determining directly the actual moisture of the soil in the cane field, with a sufficiently ready means for making such determination at frequent intervals, it would become possible to ascertain the point at which the soil moisture content fell to that point at which growth was checked. The second is indirect; to evolve from the rainfall and other data a formula which will correlate rainfall with soil humidity.

The direct determination of soil moisture

An early attempt to find a direct means of measurement was reported in 1940 when resistance blocks, made of gypsum, were devised by G. J. BOUYOUCOS at Michigan[1] and two forms have been described[2, 3]. He also devised a further system, more rapid than oven-drying, of burning soil samples with alcohol.[4] The latter was, apparently, too laborious and attention has been concentrated on the former and its modifications passing under the general term of tensiometer or, in its latest development, irrometer. A useful account of these is given by H. F. CLEMENTS in his lectures, "Sugar Cane Nutrition and Culture" delivered in India[5]. In trials with gypsum blocks he found the sensitivity to be poor in the low tension range and increasing to a useful figure only when the critical range has been passed. He also shows that, under tests carried out in Hawaii, increased yields were obtained, probably not profitable ones, at 0·25 atmospheres (wilting point 15 atm) indicating that, at the period of maximum growth, over-irrigation is impossible providing adequate aeration and drainage are present.

Tensiometer determinations have also been made by S. N. MEHRA in Pakistan[6]. The technical basis of these direct methods has been described by T. J. MARSHALL[7]. The advantage of these direct systems is that they automatically take into account, for each type of soil, the effect of rainfall. This is not the case with the indirect method.

Indirect Determination of Soil Moisture

Throughout areas of extended cultivation, such as a sugar estate, soil character is likely to change more rapidly than rainfall, though there are many exceptions—the writer at one time was in charge of a Station with an average fall of approximately 250 inches per annum, while at the town, four miles distant, the fall averaged only some 70 inches. It is unlikely, therefore, that indirect determinations can offer much more than a rough guide to the irrigation requirement of particular fields though there is a wide scope for forecasting probable total yields for the whole area.

In essence, these methods aim at finding statistically significant correlations between yield and climatic factors, and direction was given to them by R. A. FISHER's monumental and deeply mathematical analysis of the effect of such factors on the Rothamsted Wheat Plots.[8] An even earlier attempt was made by A. WALTER in his book "The Sugar Industry in Mauritius" published in 1910. His objective was to determine the potential yield of a cane crop damaged by a cyclone, using the potential, less actual yield, as a measure for crop insurance. The latest attempts at a solution along these lines have been described by A. D. SWAN[9].

In some of the above indirect approaches there is one weakness: rainfall is presented as a summation over a defined period of time. But rainfall is inter-

[1] *I.S.J.*, 1940, **42**, 73; 1941, **43**, 376.
[2] *I.S.J.*, 1944, **46**, 234.
[3] *I.S.J.*, 1956, **58**, 233.
[4] *I.S.J.*, 1942, **44**, 78, 189.
[5] *I.S.J.*, 1960, **62**, 325.
[6] *I.S.J.*, 1958, **60**, 158.
[7] *I.S.J.*, 1960, **62**, 259.
[8] *Proc. Roy. Soc.*, 1928, **B153**, 82.
[9] *I.S.J.*, 1958, **60**, 222; 1960, **62**, 122.

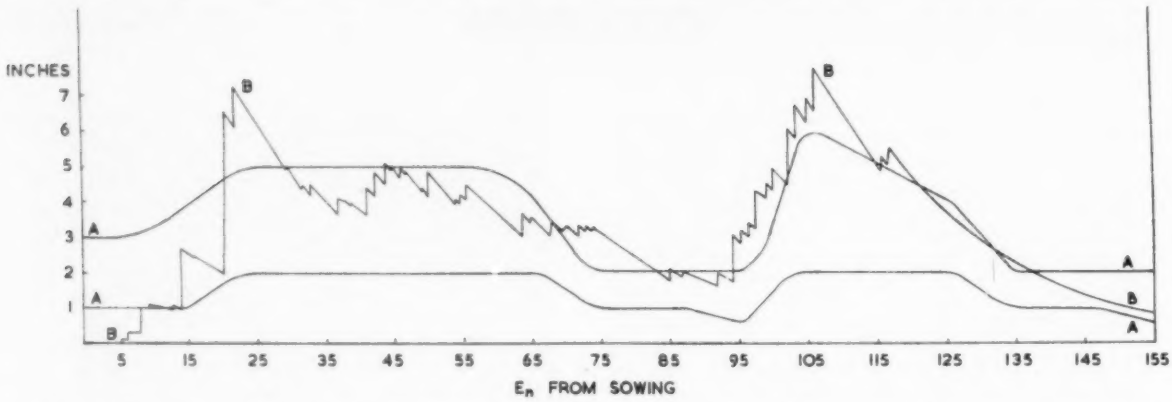

Fig. 1. The "Effective Rainfall" curve (B) for a seasonal rain of the monsoon type. Superimposed, limiting curves (A) for a for a short season crop (Cotton).

mittent and, in the tropics, a single fall may be heavy—within the writer's experience, 22 inches in 24 hours. A serious weighting of the data would result according as to whether such a fall was to occur on the last day of one, or the first day of the succeeding, period. With a view to overcoming this difficulty the writer worked out a curve, termed that of "effective rainfall" (Fig. 1), only briefly noted here as it has been described in sufficient detail earlier[10]. In this the "effective rainfall" of every day is the cumulative figure similarly obtained for the previous day less 5% plus actual rainfall for the past 24 hours[11]. His original objective here was not a study of the plant-moisture relationship but to find a method, simpler and more accurate than that in use, of preparing the official statistics of area and yield of the major crops of the Province (United Provinces, as it was then called) for which he, as Director of Agriculture, was responsible. The accuracy of the forecasts was such that in his last years as Director the method was adopted for wheat and cotton. Later, he applied the method[12] to calculate the cane yields for Barbados for the years 1911–1926 and of sugar in the same island for the years 1847–1874 and drew a comparison with Rawson's calculations.

It was noted in his article that the formula could be generalized in the form:

E_n (effective rainfall of the nth day) $= k\ E_{n-1} + r_n$ where k is a constant and r the fall measured on the morning of the nth day. It is clear from this that in this equation lay a potential and simple method of evaluating the effect of rainfall under differing soil conditions: the value of k varying with the adsorption and retentive capacity of the soil.

During the last few years an entirely new approach has been made in which the comparison between the loss from a free water surface and the calculated rate of transpiration is used as a basis for controlling moisture. The method is based on the latter calculation as devised by H. L. PENMAN[13] and has been tested at Monymusk, Jamaica[14] and in Haiti[15].

Financial Aspects

Any acceptable method of securing the necessary data relative to soil moisture with sufficient accuracy to be a guide to irrigation practice must be, on financial grounds, as simple as possible. It is perhaps unfortunate, therefore, that CLEMENTS[16] found the sheath moisture index, with its frequent collection and analysis of material, unsuitable. The use of instruments such as irrometers, must involve considerable capital cost both in purchase and installation and a recurring expense in repeated readings. Objections of a different order apply to summations of rainfall over a standard period and have been noted. The method described above for calculating the "effective rainfall" daily is not open to that objection and involves only the reading of a rain gauge after rain and a few minutes spent daily on simple calculation and entering the results on a chart. The possibility arises that herein lies the best solution of the problem in its financial aspect.

In the equation k is a constant but, to use an aphorism, it is a variable constant, its exact value depending on the soil's capacity to absorb and retain moisture. The constant k becomes a measure of those soil conditions on which an irrigation programme must be based. In the days when the method was evolved, some 40 years ago, no means, such as irrometers now provide, were available to give a check and the value of $k = 5\%$ was determined empirically by observation of the plant growth. It should now be possible, by using a few irrometers on soils of clearly differing characters, to evaluate k for the various soil types. Even simpler in practice would it be to adopt a standard chart with a constant value of k, and determine for each soil type the location of

[10] *I.S.J.*, 1934, **36**, 149.
[11] *Proc. Roy. Soc.*, 1928, **B103**, 92–96.
[12] *Tropical Agric.*, 1929, **6**, 43–45, 74–77.
[13] *I.S.J.*, 1955, **57**, 399.
[14] *I.S.J.*, 1959, **61**, 358.
[15] *I.S.J.*, 1957, **59**, 207.
[16] *loc. cit.*

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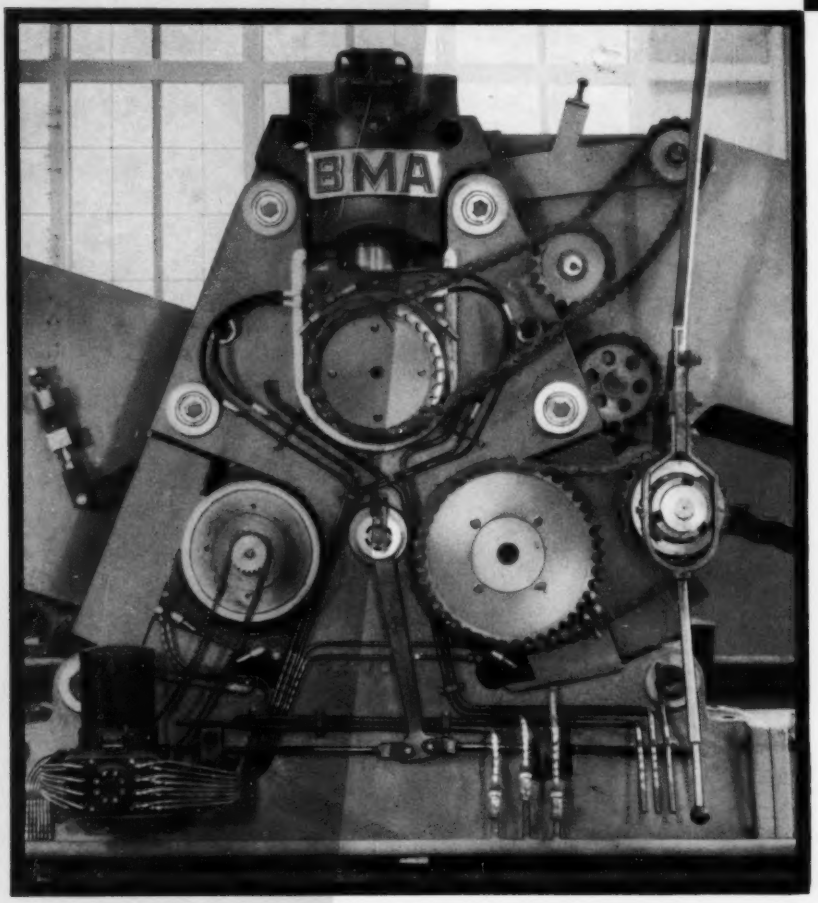

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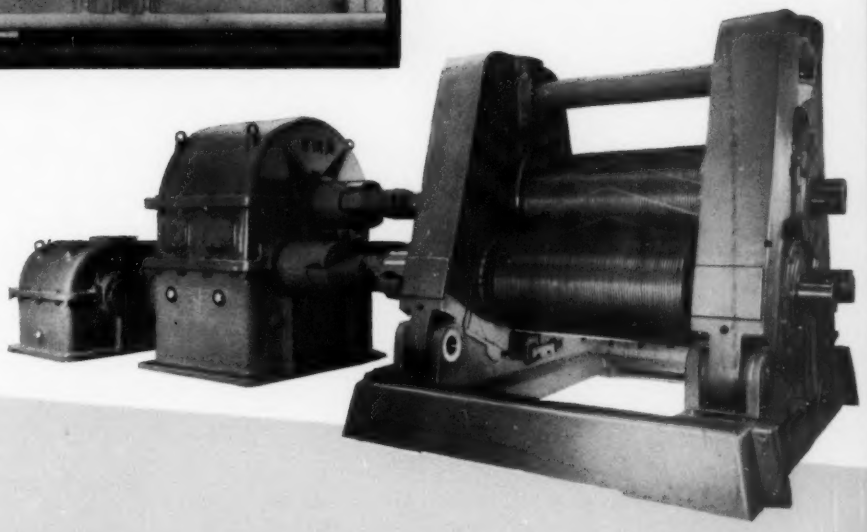

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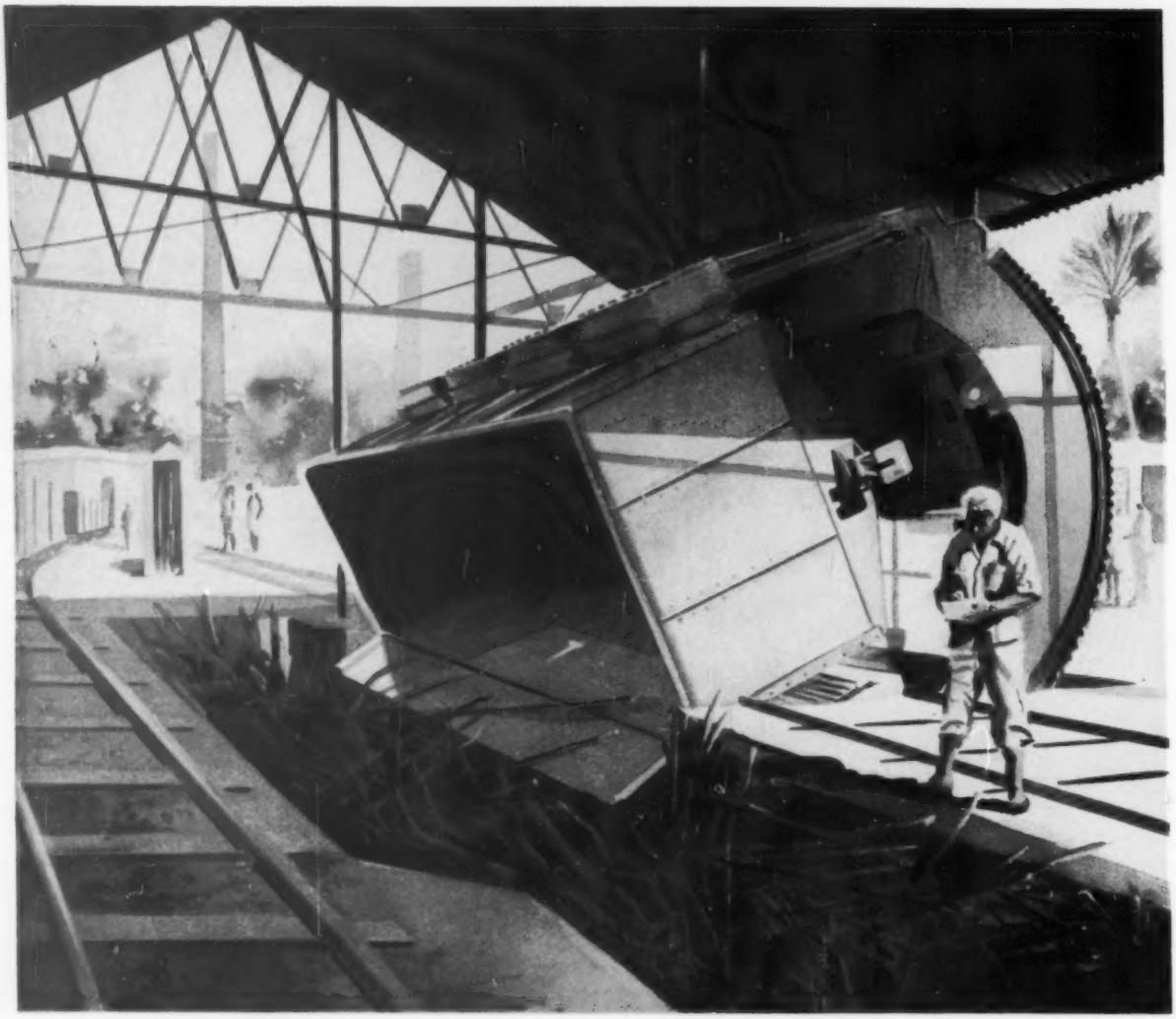

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the critical values. On an estate the essential charts could be prepared in a brief time at a minimum capital cost and with the minimum of labour, restricted to reading one, or at most, two or three rain gauges on days of rainfall only and a daily entry on each chart, merely writing off the value of k and the addition of any rainfall that occurred in the past 24 hours. In the case of sugar cane two values of k are critical, the first during the growing season, a lower value when lack of moisture is the major check to growth, and during the maturing season, when it is the higher value that will form a guide to the quality of the juice.

The subject has been dealt with earlier and more briefly with especial reference to the growing cost of statistically designed experiments[17], where a specimen curve, based on a $k=5\%$, and applied to the cotton crop in the Gangetic Plains, is given.

AGRICULTURAL ABSTRACTS

The importance of hybrid varieties in the development of the sugarcane industry of Réunion. D. D'EMMEREZ DE CHARMOY. *Rev. agric. Réunion*, 1959, **59**, 201–211.—Hybrids of *Saccharum officinarum*, *S. barberi* and *S. spontaneum* have proved to be the most disease resistant, especially with red rot, gummosis and mosaic.

* * *

Soil and water management in irrigated sugar beet fields. J. L. HADDOCK. *U.S. Dept. Agric. Farmer's Bull.*, 1960, (2149), 11 pp.—In the United States the growing of sugar beet on irrigated land is only profitable if yields are high. Advice is here given to growers on how to obtain good yields especially with regard to soil treatment and correct use of irrigation water.

* * *

The physiology of sugar cane. R. L. BIELESKI. *Australian J. Biological Sciences*, 1960, **13**, (3), 203–231. Two more papers in the series are published, (III) dealing with "characteristics of sugar uptake in slices of mature and immature storage tissue" and (IV) with effects of inhibitors on sugar accumulation in storage tissue slices.

* * *

Comparison between manual, mechanized, motor-mechanized and chemical cultivation of sugarcane in the Piracicaba region. H. DE ALMEIDA LEME, O. SAAD and M. VILLELA DE MAGALHAES MONTEIRO. *Rev. Agric.* (Piracicaba), 1959, **34**, 173–181; through *Plant Sciences*, 1960, **35**, 3971.—A detailed account is given of costs for hand hoeing, animal ploughing and discing, tractor cultivation and the chemical treatment of land (weed killers etc.) for the planting and maintenance of sugar cane. Based on cost, chemical weeding was 118 times superior to hand weeding, tractor weeding 77 times as efficient and animal discing nine times more effective than hand hoeing. One hectare was treated chemically in 64 minutes while the same area required 62 hours and 44 minutes of hand hoeing.

On the amino-acid nitrogen content of cane juices. K. C. RAO and K. V. G. AIYAR. *Curr. Sci.*, 1959, **28**, 289–290.—The amino-acid content of the juice of 9 Co varieties was estimated. It ranged from 15 mg per 100 g juice for variety Co 1244 to 59 mg for Co 1251.

* * *

Effect of ratoon stunting disease on the variety N:Co 310. Y. J. HSIA and C. S. WANG. *Taiwan Sugar*, 1960, **7**, (5), 13–17.—The paper is a comparative study of the disease incidence on two plots carried in one case to the second ratoon and, in the other, to the first ratoon. The results tend to confirm evidence elsewhere that the incidence of the disease is greater in seasons of drought.

* * *

Cultivation of spring flooded paddy sugar cane. J. C. C. CHANG. *Taiwan Sugar*, 1960, **7**, (5), 18–22.—An account of the inter-planting of rice and sugar cane, taking mainly the form of tabular statements, is given.

* * *

Progress in the development of new varieties. J. H. BUZACOTT. *Cane Growers' Quarterly Bull.*, 1960, **24**, 7–9.—The latest technique in seedling production and raising is described. As regards future progress, large advances such as followed the introduction of Q 28, Q 50, Trojan and Pindar are unlikely, for the law of diminishing returns is taking effect; instead, large numbers, each adapted to specialized local conditions, will be the probable outcome.

* * *

The diseases of sugar cane in North Queensland. C. G. HUGHES. *Cane Growers' Quarterly Bull.*, 1960, **24**, 22–26.—A general review is given of the diseases which occur in an intensity sufficient to cause losses.

[17] *I.S.J.*, 1957, **59**, 302.

THE SUGAR CANE IN THE DECCAN

Sixteenth Annual Convention, The Deccan Sugar Technologists' Association (India), 1959.

Field Studies

A PROCEDURE for conducting a soil survey of a sugar cane area is described by K. V. JOSHI. The main features of the survey used herein are profile, structure, texture, total salts % and pH, but other features, root distribution, permeability and concretions, are included. S. V. CHINCHORCAR describes the use of tensiometers for the control of irrigation and compares different forms. He notes that their use has not been started in India where, however, land under direct factory cultivation would seem to provide the sole opening for their use; the practical difficulties in the way of their adoption under peasant conditions would be very great, particularly in those tracts where intermittent canal irrigation is the rule, for the irrigation rota is determined on general grounds and not on the requirements of a single crop.

Several papers deal with the manurial requirements of sugar cane. P. V. DESHPANDE discusses the replacement of oil-cake by fertilizers and concludes that such replacement is possible. This conclusion, however, must be accepted with caution, for it is based on two years' results while both building-up and letting-down of soil fertility are long-term processes, though the latter is far more rapid than the former. A. SOMASUNDARAM *et al.* record the results of press cake and trash in various combinations with, and without sulphate of ammonia, continued over six seasons on light Chalka and heavy, black soils (regur) with both cane yield and juice quality as a measure, with press cake and groundnut cake without addition as a basis for comparison. The seasonal variations in yield are very wide and the only general conclusion drawn is that trash and press mud, in combination with sulphate of ammonia, is a satisfactory fertilizer without groundnut cake.

Two papers deal with questions concerning N availability. G. T. BABRIWALA compares the relative rate of mineralization of nitrogenous fertilizers, both organic and inorganic. From the latter, including ammonia solution and urea, N becomes readily available; from the more complex organic substances mineralization is much delayed. V. S. KULKARNI and N. V. BHIDE describe laboratory experiments on the losses of N from groundnut cake and sulphate of ammonia in alkaline soil and, in the latter, in lateritic soil. Factors which affect these losses in the former are considered and, in the latter, the greater part of the N is shown to be lost even when the uptake by the plant is taken into account. On the question of P availability, N. P. SOMAN *et al.* propose a new method for its determination, which is considered more realistic. G. K. TONAPY records trials with dicalcium phosphate dressings and finds no benefit even at deficiency levels. G. T. BABRIWALA *et al.* compares dicalcium phosphate and superphosphate on the calcareous soils of the Deccan and find the former superior; a superiority, it is suggested, due to the more rapid conversion of the latter, under the conditions of experiment, to the tricalcium form. Proportionate increases in uptake of N and K_2O are found.

Varieties

Recently four Co varieties, 678, 740, 775 and 798 have been released as being superior to the standard Co 419. G. T. BABRIWALA describes further tests at Padegaon of still later Co varieties. Of these, the outstanding, both in yield and sugar recovery, are Co 807, Co 853 and Co 948. Unfortunately the results are given in comparison with Co 419 only. Certain of the above varieties, received from Padegaon, have been submitted to a further test in the Malingar area by P. M. GOVITRIKAR and M. S. KHANDSARE under intensive cultivation. Of the varieties numbered below 801 in three years' tests, Co 678 gave the highest yields both of cane (86·27 tons per acre) and sugar (8·81 tons. Of numbers above 801, as plant canes, the leading varieties were Co 807 and Co 948, yielding respectively 77·33 and 73·00 tons cane and 8·38 and 8·83 tons sugar. The satisfactory performance of Co 678 is also briefly described by B. D. BARWE. G. T. BABRIWALA and J. K. WATAVE point out that the new cane varieties mature at different ages and their responses also vary under different conditions; it is, therefore, for each factory to make its own selection.

Earlier work by S. C. SEN and his co-workers on the use of the hand refractometer led to the formulation of certain regression equations. These equations, worked out for the whole season, do not fit the figures for seasonal determinations nor for different regions. Here is given, in great detail, the recovery % cane determined from the middle internodal Brix at different periods from November to March, Bombay-Deccan region. The importance of this work lies in the fact that proposals are afoot for including quality as one of the bases for payment of cane. The occurrence of cases of adventitious buds are noted by P. M. GOVITRIKAR and illustrated by photographs.

Physiology

The effect of spraying 2,4-D at dates ranging from January 17 to February 3 are recorded and discussed by V. P. VAIDYA. The tentative preliminary conclusion is that no increase of sugar is obtained.

Pest and Diseases

The economics of control of top and stem borers by mechanical means, defined as collection and destruction of egg masses and removal of shoots carrying larvae and/or pupae, are considered by V. O. MAHAJAN. The estimated cost is placed at Rs. 12 for Adsali crops and Rs. 9 for plant cane.

That the standard cane of the Deccan, Co 419, shows signs of degeneration is the stimulus for the search for alternative varieties. Among the causes for this degeneration is the virus disease known as grassy shoot, the control of which by hot water treatment is briefly noted by P. N. SOMAN. He makes the interesting observation, but without comment, that the old variety never suffered from the disease and notes that this cane was propagated from tops only and not from whole canes.

AGRICULTURAL ABSTRACTS

Influence of time of planting on the growth of PR 980 at Rio Piedras. S. ALERS-ALERS *et al. J. Agric.* (Univ. Puerto Rico), 1960, **44,** 45–52.—Plantings were made at 28 day intervals throughout the year and height determined monthly up to seven months. Maximum growth was attained by the May–June plantings and minimum by plantings in October–November. The major factor here appears to be the total hours of sunlight.

* * *

A review of chemical weed control in North Queensland. C. A. REHBEIN and G. BATES. *Cane Growers' Quarterly Bull.*, 1960, **24,** 27–29.—The difficulties encountered, resulting in no large-scale development, are explained and the solution suggested is a small inter-row tractor capable of working in high cane.

* * *

Grub control and varietal reaction to grub attack in the Isis area. J. ANDERSON and E. J. R. LOCKETT. *Cane Growers' Quarterly Bull.*, 1960, **24,** 30–31.—The successful control with BHC in the North has not been repeated in the South, and the reasons are discussed. Twelve varieties are listed: CP 29–116 and N:Co 310 suffer least damage, and they are strongly rooting varieties.

* * *

Variety × fertilizer tests, 1958/59. F. T. TABAYOYONG *et al. Victorias Milling Co. Expt. Sta. Release* 1960, (31), 23 pp.—A very detailed account is given of seven trials. The details have a local application but the general conclusion is that the soils involved require lime and organic matter.

* * *

A bullock-drawn sugar cane planter. R. G. MENON. *Indian Sugar*, 1960, **10,** 215–218.—This planter is the product of the Indian Institute of Sugar Cane Research. Planting in N. India, even at the present time, is done almost entirely by hand. By this simple planter, carrying a man to feed the setts, 2·5 acres per day can be planted at a cost of Rs. 30·50, or Rs. 12·20 per acre as compared with Rs. 18·40 for hand planting. (Cf. *I.S.J.*, 1960, **62,** 148.)

* * *

Establishment of seed-cane nurseries. J. GORDON. *S. African Sugar J.*, 1960, **44,** 647–649, 651.—The article notes the establishment of a Nursery Inspection Service and adds recommendations aimed at keeping the nurseries disease-free.

The nitrogen, phosphorus and potassium requirements of sugar cane. R. F. INNES. *J. Sci. Food Agric.*, 1960, **11,** 299–309.—The responses of sugar cane to N, P and K fertilizers in various sugar-producing countries are surveyed. The value of soil analyses, deficiency-symptoms observations and tissue analyses for controlling the nutrition of the plant is discussed.

* * *

Variety experiments harvested during 1957/59. F. T. TABAYOYONG. *Victorias Milling Co. Expt. Sta. Release*, 1960, (32), 15 pp.—An account of these experiments, backed by tabular statements, is given.

* * *

Varietal characteristics of the more important commercial varieties. ANON. *Sugar Bull.*, 1960, **38,** 310–312.—The characteristics of the eight more important commercial varieties of the U.S.A. are given under the headings, advantages and disadvantages. The varieties are: CP 44-101, CP 36-105, CP 44-155, CP 48-103, CP 36-13, CP 47-193, CP 43-47 and CP 52-68.

* * *

Studies of the mosaic problem in Louisiana. E. V. ABBOTT. *Sugar Bull.*, 1960, **39,** 23–26.—The reappearance of mosaic as a serious problem is discussed. Two causes are indicated, the appearance of a new strain of virus and the extended cultivation of the susceptible N:Co 310. The ultimate answer is stated to be the breeding of resistant varieties; meanwhile, rogueing of seed cane is the immediate precaution. (In this connexion it may be recalled that G. C. DYMOND claimed that the recovery of Uba from streak disease was obtained by growing diseased plants on well composted land[1].)

* * *

Agricultural extension work among the cane growers of Fiji. N. H. MONTEITH. *Trop. Agric.*, 1960, **37,** 303–308.—As is well known, in 1919, with the cessation of indentured Indian labour, C. S. R. Co. Ltd. broke up its estates into tenancies of some 10 acres. It now farms on a plantation basis only 2% of a total area of 127,000 acres. A large proportion of the tenants are illiterate and an account is given of the extension organization designed to bridge the gap between research and the individual tenants.

[1] *I.S.J.*, 1945, **47,** 203.

METHODS FOR THE ASSESSMENT OF BEET QUALITY

By A. CARRUTHERS and J. F. T. OLDFIELD
(British Sugar Corporation Ltd., Research Laboratories, Bramcote, Nottingham, England)

(*Paper presented to the 11th Meeting, Commission Internationale Technique de Sucrerie, September*, 1960

Part I—Purity Determination using a Clarified Extract from Brei

Introduction

THE basis of the assessment of sugar beet quality may vary in different countries according to the ruling price structure, the method of payment for beet and the utilization of by-products. The significance of juice purity is obviously increased if the price differential between white sugar and sugar in molasses is high, whilst a low glutamine content in beet is less desirable if mono-sodium glutamate is ultimately to be recovered from molasses. In countries where the exhausted pulp is dried for cattle food, the high cost of drying places a premium on pulp which will press to a low water content and the food value of the pulp increases with the protein content. If beet are bought solely on a weight basis the sugar content will be of overriding importance.

If beet are to be assessed in terms of more than one characteristic it is essential that the characteristics should be additive. Lacking any method of summating the properties determined by chemical composition, for example purity, with the physical properties such as filtrability, it is assumed in the present treatment that the highest quality beet are those which permit the crystallization, as white sugar, of the highest percentage of the sugar in the root.

This quality could be determined for any beet sample if it were possible to estimate the purity of the second carbonatation filtrate and of the molasses which would be produced from the beet in the factory process.

It is known that particular non-sugars in beet have different effects on the solubility and on the rate of crystallization of sucrose. These two effects are not distinguishable in the factory process because the retention time in the crystallizers is normally determined by the factory throughput and not by the ultimate exhaustibility of the molasses. It appears that in factory practice, as distinct from laboratory experiments, the purity of the final molasses is not significantly affected by such variations in composition as occur between different types or sources of beet; indeed molasses from factories using the Steffen process or the barium process for desugarisation, although of quite different composition, is still obtained at approximately the same purity as is obtained at beet factories throughout the world.

The ultimate exhaustibility of the molasses is not therefore considered to be of prime importance in evaluating beet quality and for most purposes an estimate of the purity of the second carbonatation juice would provide an adequate basis for the assessment of the quality of the beet.

Second carbonatation juice can be prepared under standard conditions after diffusion of cossettes in micro-batteries but such a process is not generally practicable for assessing beet quality because of the time consumed in the operations and the quantity of beet required. It is essential that the treatments should be replicated sufficiently to permit statistical determination of the random errors of sampling and analysis so that the precision of the results can be estimated. It is also desirable that the method should be applicable to small samples or to individual beet to facilitate selection by seed breeders.

Expressed juice can readily be obtained from the brei from small quantities of beet but the purity of expressed juice, while vaguely indicative of the purity to be expected in second carbonatation juice, is notoriously unreliable. A method is presented for preparation from brei, or beet material, of a clarified extract, the purity of which is shown to provide a reliable estimate of the purity of the second carbonatation juice which would have been obtained from the beet under standard conditions of diffusion, defecation and carbonatation.

This estimate is considered to provide a most suitable basis for comparison of the quality of beet grown from different seed varieties, with different fertilizer treatments or under different climatic conditions.

The second carbonatation juice purity at any particular factory may not be identical with that obtained under standard conditions because of bacterial attack during diffusion and sugar destruction during processing. These sugar losses are functions of the factory conditions. The purity may also be modified by additions of sulphur dioxide and of any soda ash necessary to maintain adequate pH throughout the process. The soda ash requirement will be determined by the amount of invert and sugar destroyed in the process and by the quantity of amide in the beet in relation to the amounts of

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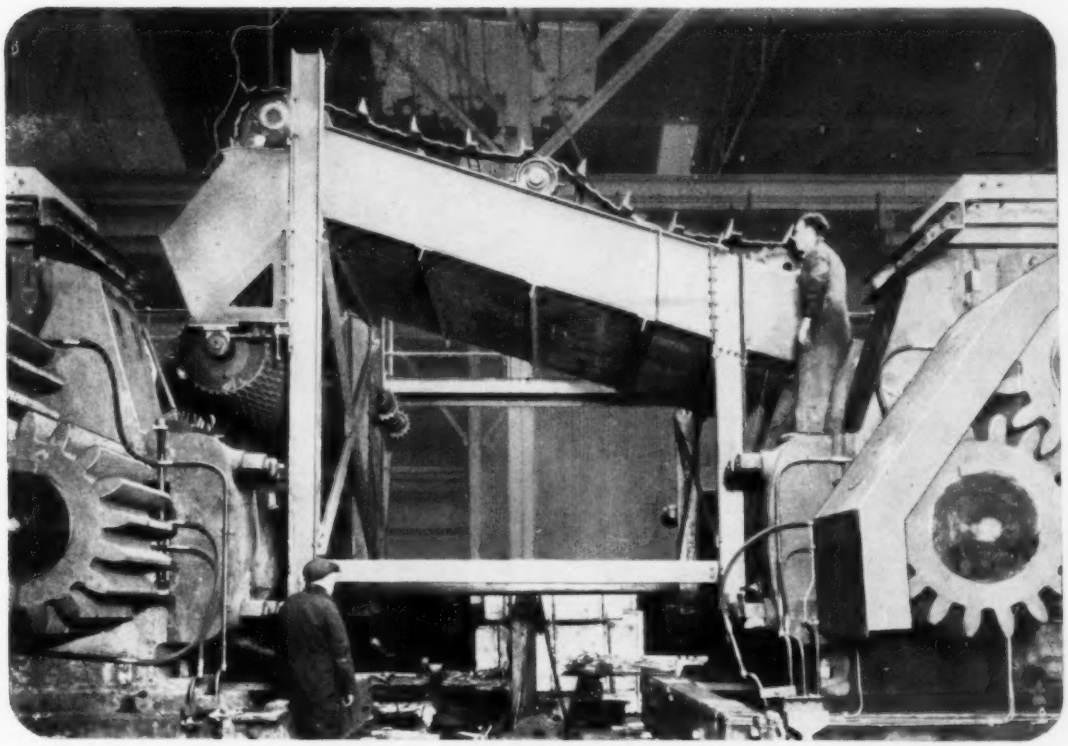

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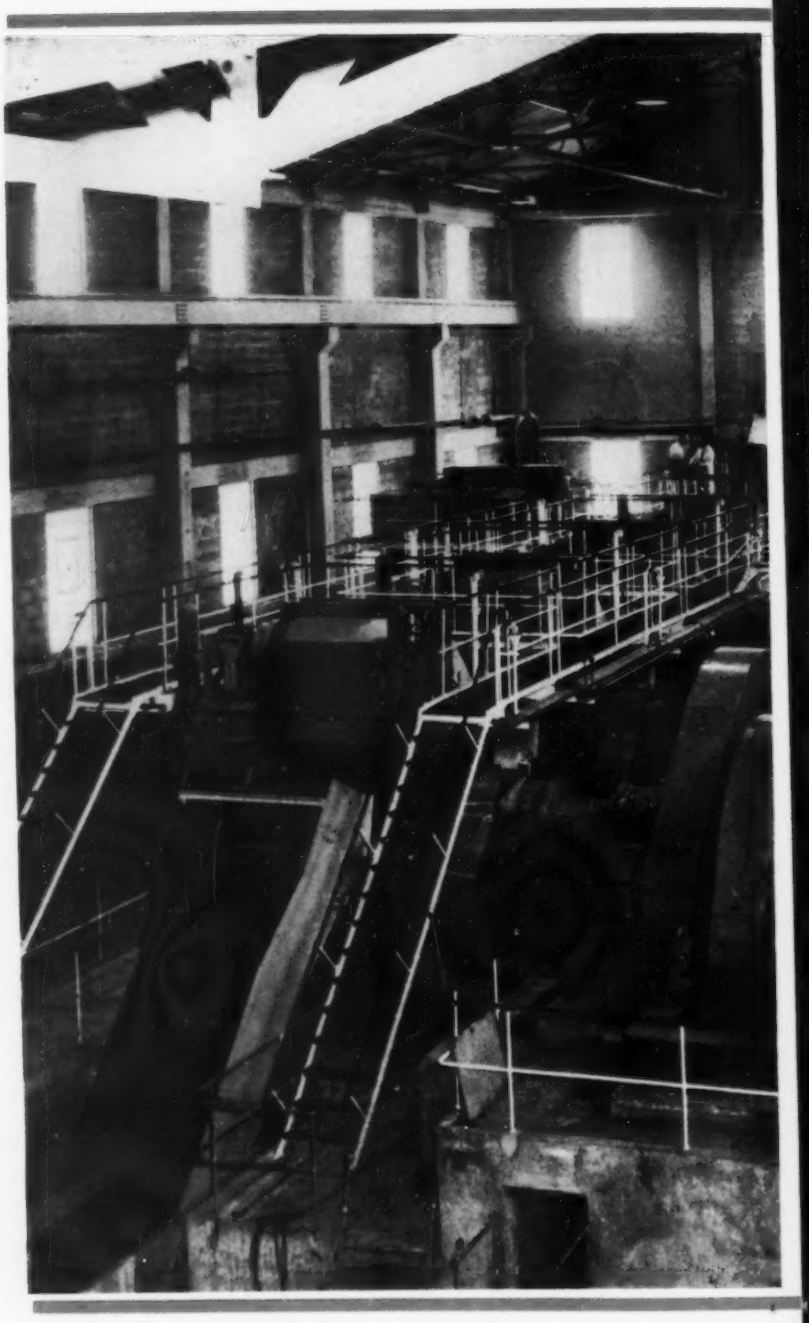

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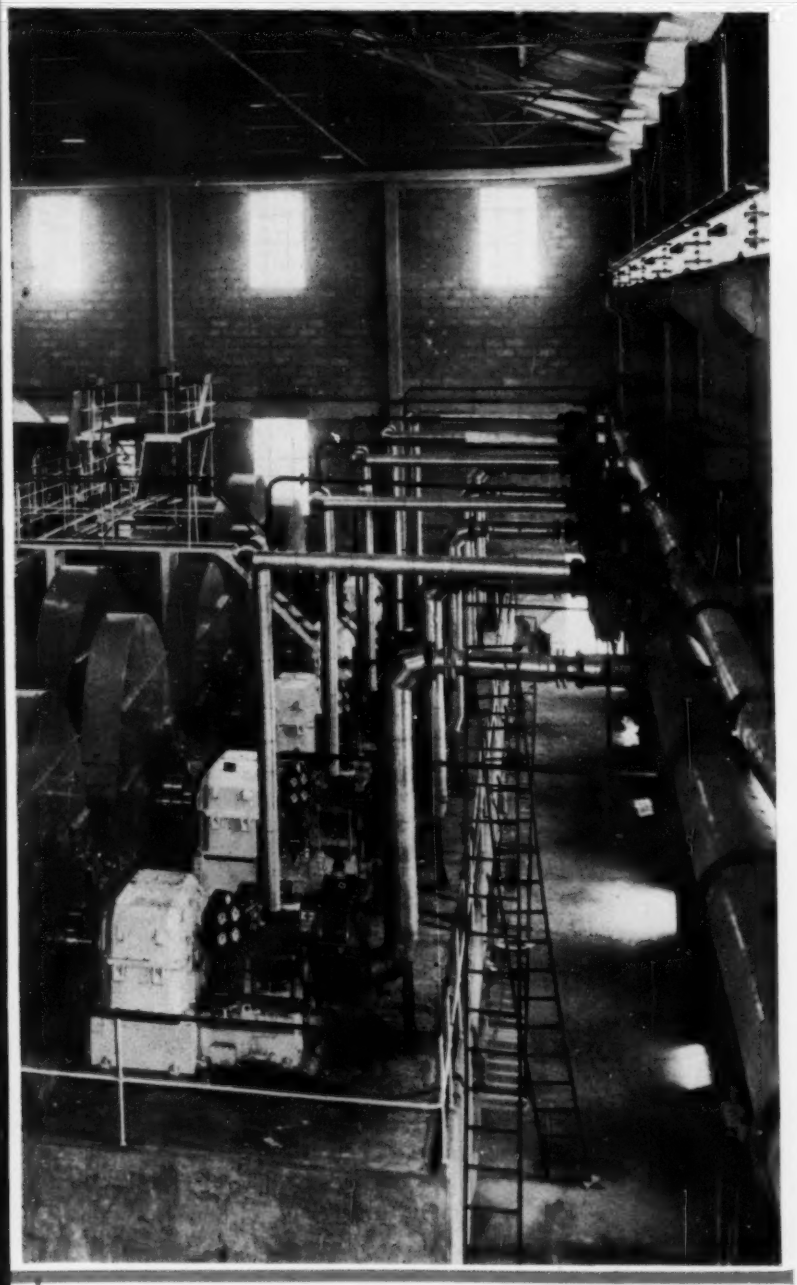

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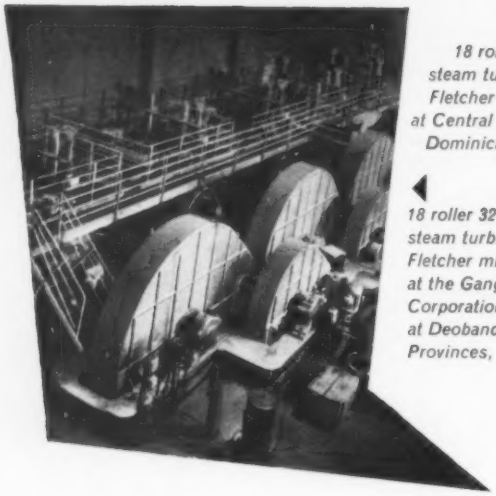

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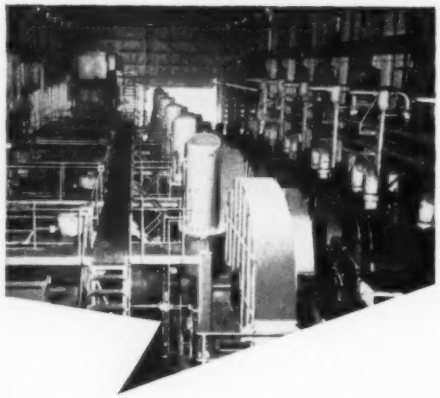

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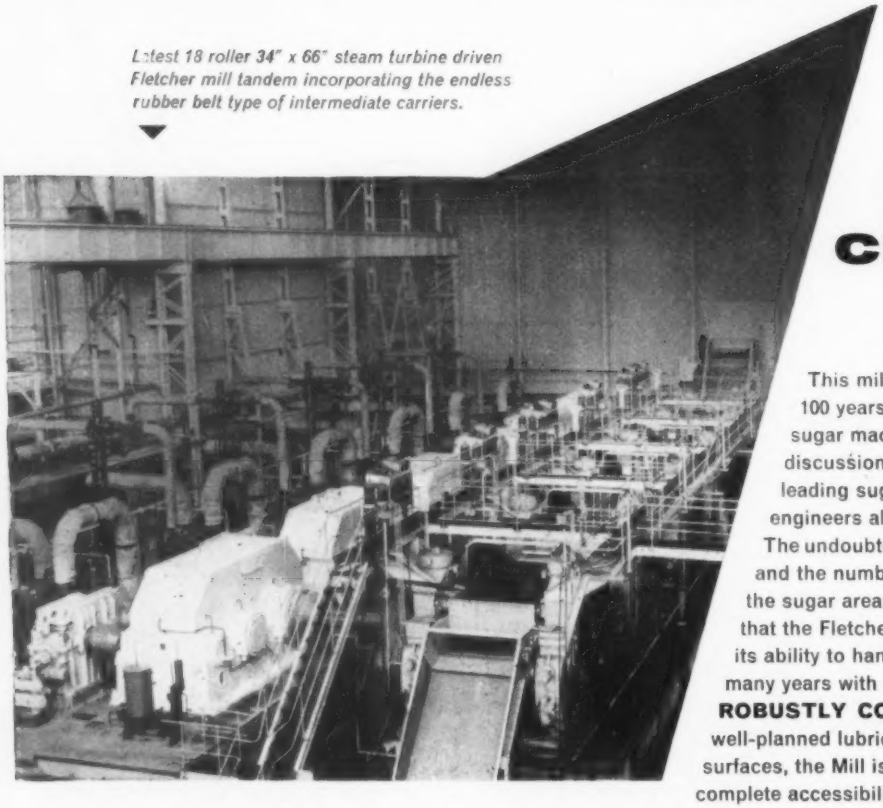

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cations and anions eliminated in clarification[1]. Additional information would therefore be necessary to assess the value of the beet for any particular factory condition.

If all the individual components of the beet could be determined and the fate of these compounds in diffusion and clarification were known, it would be possible to calculate the purity of the second carbonatation filtrate without direct measurement. Such a procedure would be impracticable but it is demonstrated that approximately 70% of the non-sugars in the second carbonatation filtrate consist of potassium and sodium salts, amino-acids and betaine.

Reliable analytical methods have been developed for the determination of these three groups of compounds in a beet extract and it is shown that the four constituents can be compounded to give an estimate of the second carbonatation juice purity which would have been obtained from the beet, while the individual values permit an assessment of the influence of the factors, other than juice purity, which contribute both to juice stability and to efficient factory operations.

The method is based on a procedure developed by BROWN and SERRO[2] in which beet juice samples were defecated with milk of lime and then clarified in two stages with saturated oxalic acid solution.

Despite the low solubility of calcium oxalate in aqueous solution, oxalic acid is not a particularly efficient reagent for de-liming juice. It has been found that, after clarification by the above procedure, the residual calcium is distinctly higher than the normal level in second carbonatation juice while some of the potassium is eliminated in the oxalate precipitate. In the present method, clarification is achieved with lime and phosphoric acid and the potassium content and residual lime salts are obtained at levels similar to those obtained in factory practice.

Method

The beet is sampled by use of a multiple saw or rasp to produce a fine brei. Alternatively, whole beet material may be employed.

If brei is available the procedure may be applied either to pressed juice obtained by the normal laboratory technique or to an aqueous extract of the brei. To obtain an aqueous extract, macerate either brei or chopped beet with 1·25 volumes of water for 10 minutes in a high speed blender and filter on a Buchner funnel. Unless the sample can be clarified without delay after production of the brei, it is preferable to heat the brei and water immediately to 75°C to inactivate invertase. If the mixture is heated it is unnecessary with brei samples to use a blender as complete extraction can be obtained by stirring.

A minimum of 50 ml of extract or juice is required.

Clarification

Cool the juice or extract to approximately 20°C. Add milk of lime equivalent to 2·0 g CaO per 100 ml of pressed juice or 1·2 g CaO per 100 ml of extract, stir, and allow to stand for 5 min. Stir the limed juice and titrate with 3M phosphoric acid to pH 11·2, using a pH meter or an automatic pH titrimeter. Heat the mixture in a water bath to 60°C and filter on a Buchner funnel. Cool the filtrate to approximately 20°C and continue the titration with phosphoric acid to pH 9·2. Heat the juice to 60°C and filter by gravity. The clarified juice is a very pale straw colour and is readily filtered.

Purity Determination

The solids content of the aqueous extract of brei or beet is only about 8% and the juice is further diluted by addition of aqueous phosphoric acid. Particular care is therefore necessary in determining the purity of the clarified juice and it is not recommended that the solids content should be determined by hydrometer.

The clarified juice is sparklingly clear and the polarization can be determined directly in a 400 mm-tube without lead acetate treatment.

The solids content of the clarified juice should be determined by direct measurement of specific gravity using a pycnometer or, preferably, by determination of refractive index using a 5th decimal place refractometer such as the Bausch and Lomb or Zeiss dipping type. Whichever method is employed, temperature control to $\pm$ 0·1°C is required in order to obtain a precision of $\pm$ 0·1 units in purity.

Results

In order to compare the purity of the clarified extract with the purity of the second carbonatation juice from the same beet, brei was prepared using a tarehouse multiple saw from a 200 lb sample of beet. The large sample was employed so as to yield a large weight of remainders from the sawn beet. An aqueous extract was prepared from the brei, while the remainders were sliced and processed to produce raw juice in the laboratory micro battery. Second carbonatation juice was then prepared under the standard laboratory conditions.

The apparent purity of the clarified brei extract is recorded in comparison with the second carbonatation juice purity for a high quality and a low quality beet sample in Table I. In addition the apparent purities of the brei extract, the raw juice and the raw juice clarified by the lime-phosphate procedure are also recorded.

Table I

Apparent purity of brei extract, clarified by lime and phosphoric acid, in comparison with standard second carbonatation juice

Sample	High quality beet	Low quality beet
Brei extract	88·7	82·9
Raw juice	90·3	84·2
Phosphated brei extract	93·0	88·7
Phosphated raw juice ..	93·2	88·7
Second Carb. juice ..	93·2	88·7

[1] CARRUTHERS: *I.S.J.*, 1959, **61**, 376.
[2] *Proc. Amer. Soc. Sugar Beet Tech.*, 1954, **2**, 274; *I.S.J.*, 1956, **58**, 110.

Within the limits of the purity determination the apparent purity of the clarified brei extract is not distinguishable from that of the second carbonatation filtrate.

To determine whether the juices were similar in constitution, as well as in apparent purity, the concentrations of the principal cations and of betaine and invert were determined. The results are recorded in Table II.

Table II

Analysis of brei extract, clarified by lime and phosphoric acid, in comparison with standard second carbonatation juice

Sample	K	Na	Ca	Mg	Betaine	Invert
	mg/100 S					
High quality beet—						
Brei extract	1180	61	110	200	1360	380
Raw juice	1250	66	24	176	1410	370
Phosphated brei extract	1190	63	13	<1	1380	420
Phosphated raw juice ..	1240	65	15	<1	1400	360
Second carb. juice ..	1250	62	16	<1	1410	60
Low quality beet—						
Brei extract	1750	78	78	338	1840	—
Raw juice	1760	66	44	223	1860	—
Phosphated brei extract	1740	72	13	<1	1830	—
Phosphated raw juice ..	1750	66	10	<1	1840	—
Second carb. juice ..	1740	64	31	<1	1870	—

The recorded values show no significant differences between the brei extract or juice clarified by the lime-phosphate treatment and the second carbonatation juice except that the invert is not destroyed by the new procedure. Although invert is destroyed in normal clarification, very little of the product is eliminated and consequently the survival of invert in the phosphate treatment does not appreciably affect the apparent purity of the clarified juice.

To compare the purity of the clarified brei extract with factory second carbonatation juice, samples of brei were collected over a period of four hours from the tarehouse sampling of all the beet entering Colwick factory. To inactivate invertase, each sample of brei obtained was immediately heated to 80°C with water and thymol was added to prevent bacterial attack during collection of the composite sample. A composite sample of second carbonatation juice, also preserved with thymol, was collected over the four hour period in which the particular beet were processed. The purities of the clarified brei extract and of the factory second carbonatation juice are recorded below:—

Apparent Purity, Clarified Brei extract	92·1
Factory Second Carbonatation juice	91·1

The lower purity of the factory second carbonatation juice implies that the factory juice is obtained at a lower purity than the second carbonatation juice prepared in the laboratory. This is to be expected because of sugar destruction by micro-organisms during factory diffusion. As this sugar loss is a function of the factory conditions rather than of the beet quality, the purity difference does not invalidate the use of the purity of the clarified brei extract as a measure of beet quality.

Discussion

Treatment of the limed brei extract with phosphoric acid is superior to de-liming with oxalic acid. The use of 3M phosphoric acid instead of saturated oxalic acid (0·8M) reduces the dilution during clarification.

If a solution containing 0·3% potassium chloride and 10% sucrose is submitted to the lime and oxalate procedure about 10% of the potassium is eliminated in the oxalate precipitate. A similar effect is obtained when juice is clarified by the oxalate procedure but no co-precipitation occurs with the phosphate method. A sample of raw juice was clarified, in duplicate, by the procedure detailed above and also by a similar treatment with oxalic acid. The purity and cation contents of the clarified juices are recorded in Table III.

Table III

Comparison of de-liming with phosphoric and oxalic acid

	Raw Juice	Phosphate procedure I	Phosphate procedure II	Oxalate procedure I	Oxalate procedure II
Apparent purity	—	88·1	88·1	88·0	88·1
Ca mg/100S ..	—	10	7	270	345
K mg/100S ..	1860	1855	1860	1510	1440
Na mg/100S ..	74	75	74	50	48

Although no significant differences in purity were detected between the two procedures the phosphate procedure is to be preferred because the clarified juice is similar in composition to that obtained in the factory process.

The phosphate procedure has been investigated to determine whether the two stage de-liming is essential and it has been found that if the first filtration stage is omitted the juice will not filter readily and the clarified juice is much more highly coloured.

It is possible to avoid the successive cooling and heating of the extract by defecation with lime at 60°C and addition of the phosphoric acid also at 60°C. If colorimetric indicators are used to estimate the end points, the apparent purity of the clarified extract is generally lower than that obtained by the recommended procedure. When adding the relatively concentrated phosphoric acid solution, even a slight excess will depress the purity of the clarified juice because of the weight of the excess acid. The correct end point can, however, be determined by direct measurement of pH at 60°C using a temperature compensated pH meter and a stable glass electrode. It is necessary to determine the pH to be measured at 60°C which will correspond to pH 11·2 and 9·2 measured at 20°C. With samples of British juice the two titration end points are obtained at pH_{60} 11·0 and pH_{60} 8·9.

The use of a constant temperature throughout the clarification procedure may facilitate the automation of the process for the examination of large numbers of samples.

(*To be continued*)

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THE FATE OF CANE JUICE SIMPLE SUGARS DURING MOLASSES FORMATION

II. Hexose Interconversions

By W. W. BINKLEY
(New York Sugar Trade Laboratory, 37, Warren Street, New York 7, N.Y., U.S.A.)

THE principal cane juice hexoses, D-glucose and D-fructose, participate in the formation of melassigenic substances during raw sugar production. The study of the action of heat on model systems containing these hexoses has been a popular subject in carbohydrate chemistry for more than half a century. The dominant reactions are transformations, dehydrations and condensations[1]. The transformations in these model systems were named after the original investigators, LOBRY DE BRUYN and ALBERDA VAN EKENSTEIN[2].

The transformations of the hexoses in cane juice occur in a more complex environment[3]. In the continuance of our studies of the fate of the simple cane juice sugars during molasses formation, we have been examining a phase of the LOBRY DE BRUYN—ALBERDA VAN EKENSTEIN transformations in heated cane juice with added radio-carbon (^{14}C) sugars. We wish to report herein some of the findings of this work.

EXPERIMENTAL

The cane juice used in this work was reconstituted from lyophilized whole mixed raw juice. The analysis of the lyophilized cane juice solids has been published[4].

Application of Heat at 95-97°C to Limed Cane Juice With Added Radioactive Sugars

Eighteen grams of lyophilized cane juice were dissolved in sufficient distilled water to produce 150 g of solution. The clarified limed juice was obtained as described previously[4]. The added radioactive sugars were D-glucose-1-^{14}C, 50 microcuries, (New England Nuclear Corp., Boston., Mass., U.S.A.) and D-fructose-1,6-^{14}C, 30 microcuries (U.S. National Bureau of Standards, Washington, D.C., U.S.A.). One of these was admixed with the clarified, limed juice just prior to the application of the heat at 95-97°C. The juice, mechanically stirred, was heated at 95-97°C for 48 hours in a flask equipped with a reflux condenser. Lyophilization followed by drying at 25°C under reduced pressure with phosphoric anhydride of measured aliquots of the reaction mixture was used to isolate its solids. The radioactivities of these solids before and after the heating, respectively, were as follows: 3·01 and 2·99 μc/g, with added D-glucose-1-^{14}C; 1·67 and 1·63 μc/g with added D-fructose-1,6-^{14}C. The radioactivities of these products were measured by the New England Nuclear Assay Corp.

Fractionation by Membrane Diffusion of the Limed Cane Juice Heated With Added Radioactive Sugars

The volume of the heated limed cane juice was adjusted with distilled water to 500 ml. This mixture was poured into a membrane bag made from a 26 inches length of cellulosic tubing 2·25 inches dia. and 0·0023 inches wall thickness (Central Scientific Co., Chicago, Ill., U.S.A.). The contents of the bag, saturated with toluene and continuously stirred mechanically, were dialysed against 1800 ml of toluene-saturated distilled water for 24 hr. The remainder of

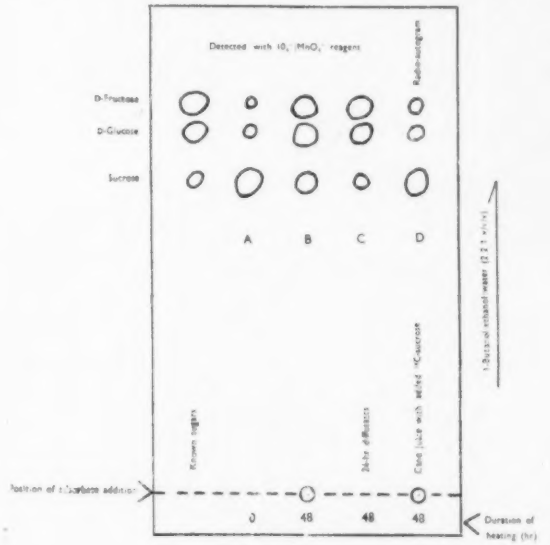

Fig. 1

the dialysis will be the subject of a subsequent article. The non-volatile diffusates from the 24 hr dialysis were isolated by a combination of reduced pressure evaporation at 60°C, lyophilization and drying at 25°C under reduced pressure with phosphoric anhydride; the yield was 8·08 g. The radioactivities of these diffusates were as follows: 3·33 μc/g with added D-glucose-1-^{14}C and 1·56 μc/g with added D-fructose-1,6-^{14}C.

PAPER CHROMATOGRAPHY OF THE REACTION PRODUCTS

Spot Detection by Colour Change.—Two to four additions of the reaction mixtures before and after 48 hr heating and of a solution of the diffusates from

[1] SPECK: *Advances in Carbohydrate Chem.*, 1958, **13**, 63.
[2] *Rec. trav. chim.*, 1895, **14**, 203; 1897, **16**, 262.
[3] BINKLEY and WOLFROM: *Advances in Carbohydrate Chem.*, 1953, **8**, 291.
[4] BINKLEY: *I.S.J.*, 1959, **61**, 173.

the latter were made at designated positions on a 23 × 28 cm sheet of Whatman No. 1 filter paper. The paper chromatogram was developed at 20°C with 1-butanol:ethanol:water (2:2:1 v/v/v) and was dried in air at 25°C. It was developed and dried two additional times. The chromatogram was sprayed with sodium metaperiodate-potassium permanganate reagent[5] and is shown in Fig. 1.

Radioautogram.—An identical chromatogram was prepared from a 23 × 28 cm sheet of Whatman No. 3 filter paper and was developed in the same manner. The dried chromatogram was allowed to remain in contact with Type KK x-ray film (Eastman Kodak Co., Rochester, New York, U.S.A.) for 4 to 8 weeks. The film was developed and dried. The results are presented in Fig. 2.

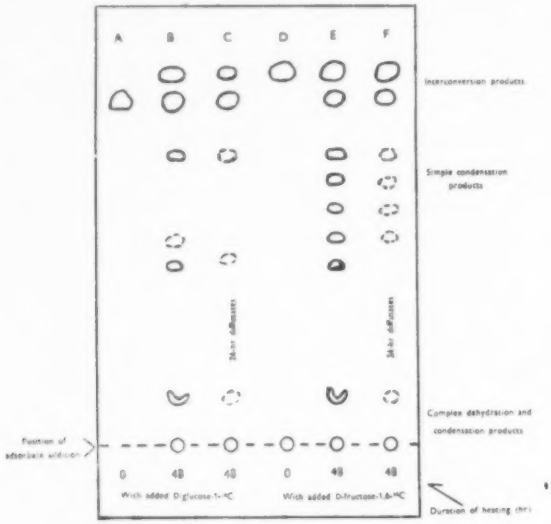

Fig. 2

A separate radioautogram of the 48 hour reaction mixture from heated limed cane juice with added sucrose uniformly labelled with radio-carbon (^{14}C)[4] was made and is depicted also in Fig. 1.

Scanning.—Four to six additions of the adsorbate solutions were made at the designated locations 8 cm from and parallel to the shorter edge of a 23 × 52 cm sheet of Whatman No. 3 filter paper. The descending chromatogram was developed at 20°C for 40 hr with the same solvent system. The chromatogram was scanned by the Atomic Accessories Inc., Valley Stream, N.Y., U.S.A. The scannings are depicted in Fig. 3.

Results and Discussion

Paper chromatography employing spot detection by colour indicated that the loss of some sucrose and increase of hexoses had occurred in heated limed cane juice (Fig. 1 A and B). The chromatograms provided little other insight to the chemical changes occurring during molasses formation. Verification of the partial decomposition of sucrose during molasses formation was obtained with a radioautogram of the heated juice with added sucrose uniformly labelled with carbon-14 (Fig. 1 D).

Radioautograms of heated limed cane juice with added D-glucose-1-^{14}C or D-fructose-1,6-^{14}C indicated that hexose interchange had occurred (Fig. 2 B and E). The principal hexose products are D-glucose and D-fructose. The formation of D-mannose in model systems containing these sugars has been demonstrated over a broad range of temperatures and pH[1]. Since the presence of this hexose in molasses is doubtful[6], the processes in raw sugar production would not appear to yield it in significant quantities.

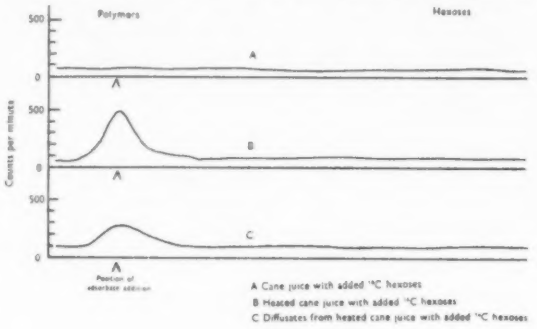

Fig. 3

The generation of trace amounts of D-psicose is probable; convincing experimental support for its presence in model systems is still lacking. However, the presence of this 3-ketose in distillery slops from cane molasses has been claimed[7].

Simple and complex condensation products (Fig. 2) were obtained in the preparation of a molasses-type "browning" polymer(s) from heated limed cane juice. The simple condensates appeared in the di- and tri-saccharide regions (Fig. 2 B, C, E and F) of the radioautogram; D-fructose was more active than D-glucose in their formation. These substances will be the subject of a future article. The complex condensates (polymers) were coloured and nitrogen-bearing[8]. The diffusate and dialysable polymers remaining at the position of adsorbate addition (Fig. 2 B and E) are at present under investigation; isolation of the more mobile polymer is in progress. The principal cane juice hexoses participate in the production of these polymers (Fig. 2 B and E). The D-fructose-1,6-^{14}C possessed a trace of polymeric substances (Fig. 2 D). The molasses melanoidins are products of the two other dominant reactions occurring during the Lobry de Bruyn-Alberda van Ekenstein transformations, namely condensations and dehydrations.

Additional clues to the reaction patterns of the principal cane juice hexoses during molasses formation

[5] Lemieux and Bauer: *Anal. Chem.*, 1954, **26**, 920.
[6] Blair: *Ph.D. Dissertation* (Ohio State University), 1947.
[7] Zerban and Sattler: *Ind. Eng. Chem.*, 1942, **34**, 1180.
[8] Binkley: *I.S.J.*, 1959, **61**, 364.

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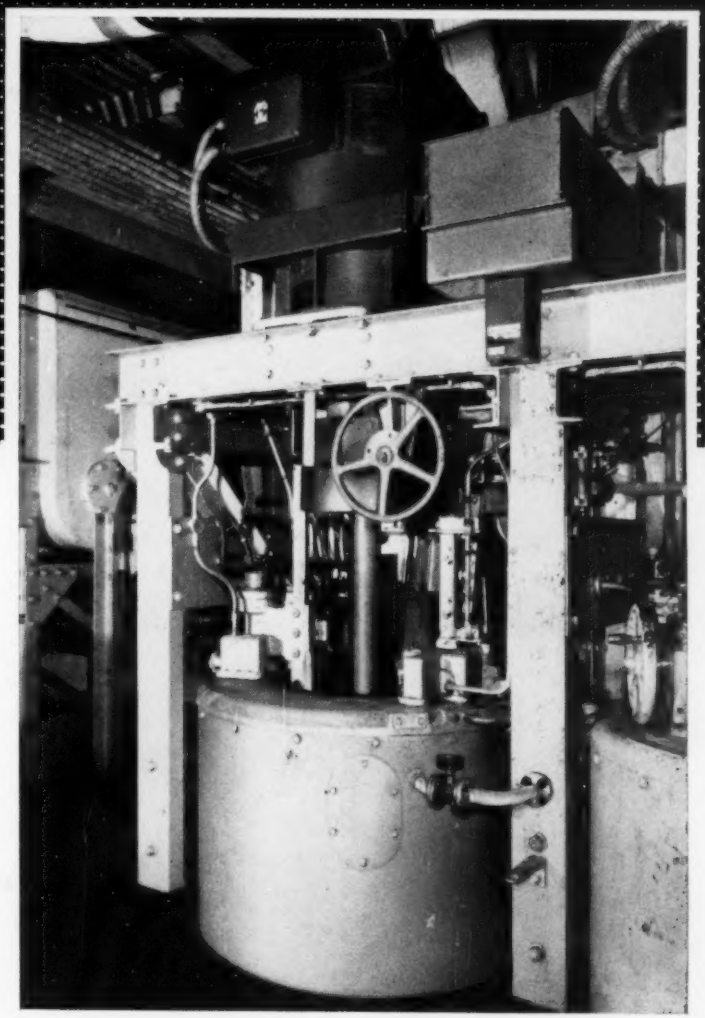

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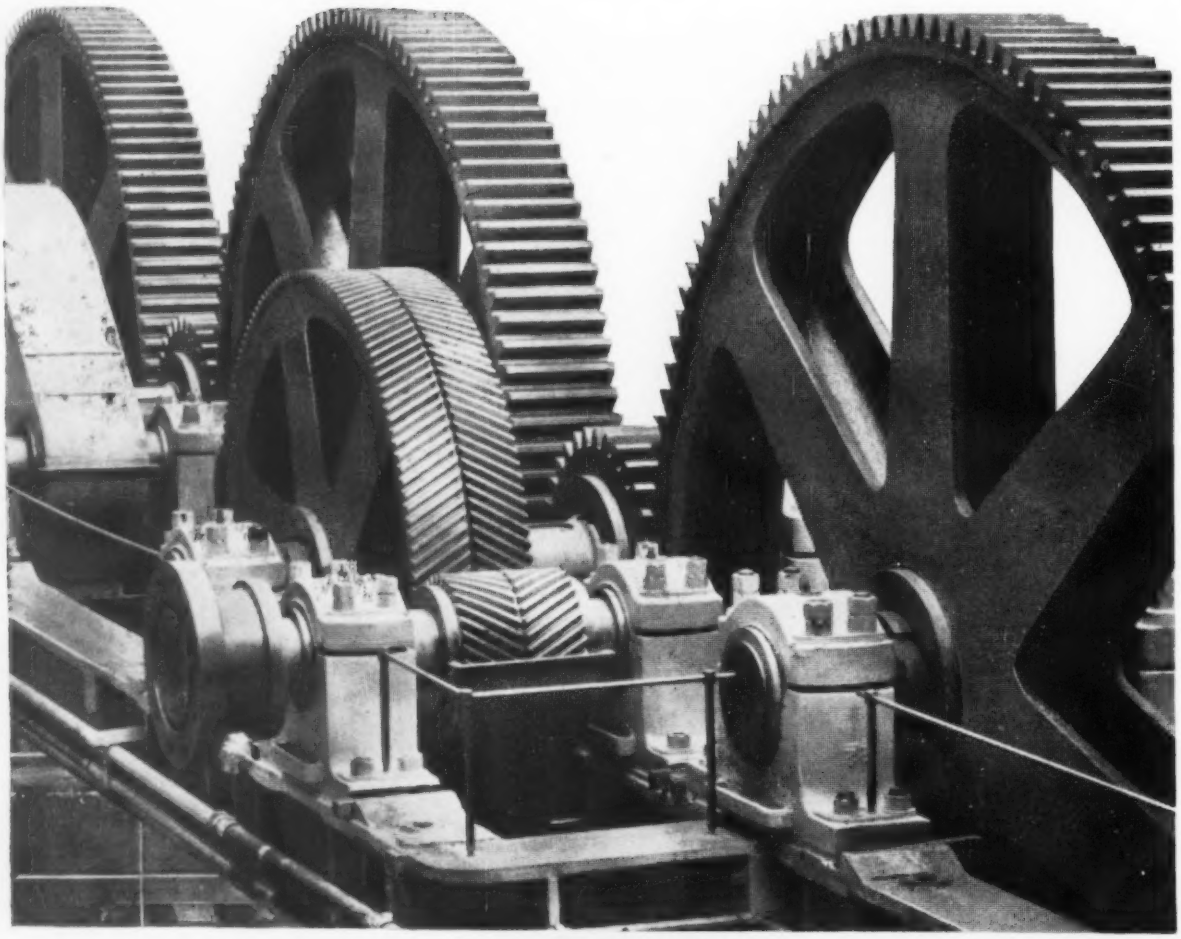

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were sought by scanning techniques (Fig. 3). These scans indicated only that the area of the chromatograms containing "browning" polymers possessed the greatest radioactivity.

SUMMARY

The action of heat on limed cane juice led to the formation of hexose interconversion, condensation and polymerization products. D-Glucose and D-fructose interconversions were established from chromatographic and radio-tracer studies. Residues from both hexoses were present in the molasses melanoidins. D-Fructose yielded several simple condensation compounds.

ACKNOWLEDGMENT

The writer wishes to thank Dr. L. F. MARTIN, Head, Sugarcane Investigations, United States Department of Agriculture, for the lyophilized cane juice.

PERFORMANCE OF CONTINUOUS CENTRIFUGALS IN PERU

By FELIX PROSKOWETZ[1] and JAMES C. P. CHEN[2]
(Ingenio Casa Grande, Peru).

CONTINUOUS centrifugals have been working in Casa Grande since 1955, and success seems to be much nearer. We now have four machines of three types from two different makers, Escher Wyss of Zürich and BMA of Braunschweig, Germany. The comparative data from these installations are interesting.

Continuous Centrifugals for Affination

The first continuous centrifugal in Peru was an Escher Wyss horizontal push-type model C-4/4, specified by the makers as suitable for massecuite of 93°Bx and 86 purity, yielding runoff of 88°Bx and 70 purity. Running at 70°C and 900 r.p.m. the output of affined sugar is 6 tons/hr. Power consumption is normally 18 h.p.

The machine worked alongside three 44 in × 25 in × 960 r.p.m. conventional centrifugals. It was promising for affination but unsuitable for a product which had to be bagged, because the output was wet, lumpy, and contained many broken crystals.

In 1958, two additional Escher Wyss machines (model C-4) were obtained. These had automatic feeding, and with the same quality of massecuite and at 900 r.p.m. the output of affined sugar was 8 tons/hr. Power consumption was 25 h.p.

Table 1 shows comparative results for the C-4 and a batch centrifugal.

Continuous machines now do all the affination work. We have found that the position of the wash water nozzles is critical both in controlling the amount of lumps and the colour of the washed sugar. But the C-4, although suitable for affination, is not suitable for sugar which has to be bagged.

Continuous Centrifugals for Low Grade (C) Massecuite

For final strikes we have at Casa Grande
six 45 in × 24 in, 1500 r.p.m. centrifugals
plus six 42 in × 24 in, 1500 r.p.m. ,,
plus one vertical spindle continuous BMA machine. This has a diameter of 650 mm (25·6 in), runs at 2450 r.p.m., and with feed at 45°C is rated by BMA at 2 tons massecuite/hr. Comparative data are given in Table 2.

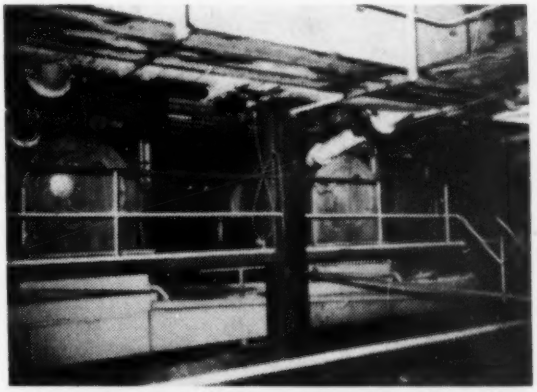


Fig. 1—The three Escher Wyss continuous centrifugals for affination operation

The Glucose/Ash ratio in Peru is low, averaging about 1·1. This explains the high (True) Purity of the molasses.

On two occasions grain found in molasses from the BMA centrifugal was due to small holes developing in the cloth. These holes were welded.

Capacity of the BMA machine was 1·1–2·6 tons massecuite/hr., the temperature of the massecuite being rather critical.

It was also found that the application of steam at the BMA machine will raise the sugar purity from 75% (without steam) to as high as 96% (with steam) without influencing the purity of purged molasses.

[1] General Superintendent.
[2] Research Technologist.

Table 1—Comparison of Affination Sugar Quality from Batch and Continuous Centrifugal

	Purity	*Glucose (% on solids*)*	*CaO (% on solids*)*	*Total Ash (% on solids*)*	*Colour† (—log T_{560})*	*Output (tons sugar /hr.)*
Batch Centrifugal						
Purging time 180 sec, sugar wall 4¼ in, wash water 60 litres per ton sugar	99·50	0·169	0·016	0·24	38	—
	99·50	0·216	0·016	0·30	44	—
	99·35	0·232	0·016	0·30	43	—
Average	99·45	0·206	0·016	0·28	42	3·6
Continuous Centrifugal (Escher Wyss) wash water 60 litres/ton sugar	99·83	0·186	0·016	0·19	36	—
	98·52	0·108	0·016	0·16	33	—
	99·66	0·102	0·017	0·14	32	—
Average	99·34	0·132	0·016	0·16	34	8·0

* Sugar analysis done at 60–65°Bx. and calculated to 100% solids. † Measured at 50°Bx.

Table 2—Comparison of Low Grade Sugar Quality from Batch and Continuous Centrifugals

C-Massecuite		*Batch Centrifugal Molasses*			*BMA Continuous Molasses*		
Temp/°C	*Purity*	*Brix*	*True Purity*	*Sugar Purity*	*Brix*	*True Purity*	*Sugar Purity*
49·0	58·09	95·93	40·94	87·45	95·01	43·90	90·33
45·0	57·95	94·09	45·84	89·62	92·71	44·02	92·07
50·0	60·43	95·47	48·49	—	94·09	45·59	—
52·0	60·38	96·39	48·83	—	95·47	46·61	—
51·0	62·48	97·31	46·65	87·97	95·47	49·26	94·93
47·0	59·89	94·10	46·54	92·62	92·30	45·82	95·57
40·0	61·15	94·09	47·41	92·56	93·17	45·79	94·83
47·0	63·91	92·71	49·44	91·88	92·26	49·17	94·04
43·0	62·55	92·71	49·60	93·45	90·88	52·64	95·53
40·0	59·33	92·26	48·10	92·44	92·71	48·30	91·24
46·0	61·82	95·47	48·66	93·99	95·47	49·79	92·96
47·0	60·73	94·59	47·32	91·33	93·59	47·35	93·50

In general, both the Brix and the purity of the BMA molasses was lower than the daily average molasses from batch centrifugals. With a BMA machine there is no loss due to " overcharging "; if the machine is overfed massecuite will mix with sugar and not with molasses.

A trial of the BMA machine on 1st Massecuite gave satisfactory purging of syrup, but the grain was destroyed.

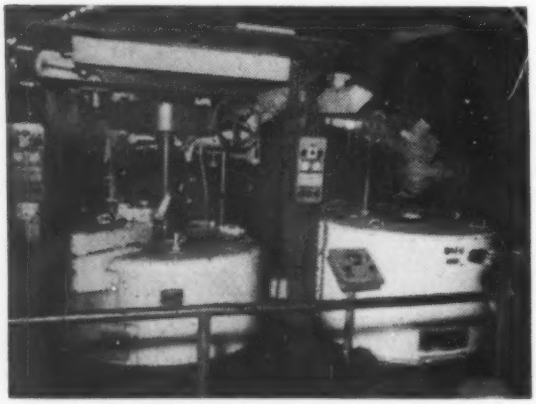


Fig. 2—The BMA continuous centrifugal and the conventional batch centrifugal working side by side for close comparison

Summary

(1) *Escher Wyss Horizontal Centrifugals*

Model C-4 is satisfactory for affination in Peru. It is economical in power usage and in labour. One man attends three centrifugals, the melter and the pumps. Prime cost was about the same as European batch machines.

The first Escher Wyss has now worked for 40–44 months, and there are no special problems in maintenance.

(2) *BMA Vertical Continuous Centrifugal*

This machine on low grade massecuite shows much promise. For the same purity of molasses it gives better sugar, thus reducing recirculation of impurities. Capacity exceeded the specification. Temperature of massecuite is very important.

Unless the screen is defective, massecuite cannot get into molasses. Sugar loss by " overcharging " is thereby avoided.

Capital cost was only 65% of that of a (European) batch centrifugal having the same capacity. Labour, power and maintenance costs are all lower. The use of steam in the continuous centrifugal was very advantageous.

The principal maintenance item is the screen. The first screen lasted three weeks, a heavier replacement developing one hole after four weeks. The third (same as No. 2) lasted 44 days. Still better screens are now available.

STRUCTURE OF COAGULATED COLLOIDS OF SUGAR BEET JUICE

(I) Volume and shape of hydrated mud particles of progressively predefecated juice

By RUDOLF KOHN and ZORA KOHNOVÁ

(Czechoslovak Academy of Sciences Chemical Institute, Slovak Academy of Sciences Bratislava, Czechoslovakia)

Introduction

THE importance of the DEDEK-VAŠÁTKO method of progressive predefecation is generally known. From the theoretical aspect VAŠÁTKO was mainly concerned with the study of reversibility of coagulation of sugar beet juice proteins[1]. SILIN[2], on the basis of model tests with egg albumen explained the importance of Ca^{2+} ions for the coagulation of proteins in the sucrose solution. BAERTS *et al.*[3] and SILIN[2] have also dealt with the formation of insoluble lime salts of inorganic acids and their peptization during progressive predefecation.

The authors of the D-V method explain the marked improvement of filtration and sedimentation properties of the turbid carbonatated juice attained through progressive predefecation by the gradual coagulation of colloids in the so-called *metastable sphere of coagulation*. A compact coarse-grained precipitate with a small surface is obtained, which differs from the single addition of $Ca(OH)_2$, when the coagulation of colloids takes place at once and a finely-grained precipitate with a relatively large surface is formed

DEDEK[4] later attributed the basic difference in the properties of coagulated colloids of progressively predefecated juice and juice defecated by a single addition of $Ca(OH)_2$, mainly to their different hydration. This, it was considered by DEDEK, is caused by the different degree of exchange of K^+, Na^+ and H^+ for Ca^{2+} ions, which results from the effect of $Ca(OH)_2$ on the colloids during their coagulation.

A perfectly progressive alkalinity rise sought by the authors of the method was attained by BRIEGHEL-MÜLLER in progressive predefecation carried out in counter-current[5]. The marked improvement of filtration of turbid carbonatated juice BRIEGHEL-MÜLLER attributes to the so-called stabilization of sugar beet juice colloids as well as to the smooth progressive rise of alkalinity during predefecation without any local over-liming[6].

Theoretical considerations of the colloido-chemical processes which take place in progressive predefecation have often been deduced analogously from properties of other dispersion systems. So far, however, there is a lack of experimentally proved findings on the ion-exchange properties of sugar beet juice colloids, on ion exchange during their coagulation due to the effect of $Ca(OH)_2$, on the particle shape of coagulated sugar beet juice colloids, on their hydration, on the force of their mutual bond, space arrangement in aggregates, etc.

In a previous paper[7] we have shown that sugar beet juice colloids, which have not been removed by defecation and carbonatation, i.e., which remain in the clear carbonatated juice, do not in practice affect the filtration properties of the turbid juice. These depend entirely on the structure of the mud aggregates; therefore research has to be aimed in this direction.

This paper is part of a complex theoretical research on the purification of sugar beet juice, a problem dealt with by our Institute. The aim is to elucidate the structure of aggregates of sugar beet juice colloids coagulated with calcium hydroxide. We examine the total volume and shape of hydrated mud particles, the force of their mutual bonds, their space configuration in aggregates etc. TIBENSKÝ[8], working in our Institute in another field of research closely connected with these problems, dealt with the study of ion exchange during the coagulation of colloids and with some questions connected with the so-called stabilization of colloids. These will be discussed in a subsequent paper.

Experimental

Analytical methods and methods of colloido-chemical analysis

Diffusion juice.—We worked with both factory diffusion juice and with diffusion juice prepared on the D.d.S.-type laboratory diffuser. The diffusion juice was analysed by methods described in our previous paper[7]. We determined diffusion juice colloids by the method of DUMANSKII and CHARIN[9].

The diffusion juice was progressively predefecated at a temperature of 80°C to 85°C for 10 minutes. For a coagulating agent we used a lime sucrate solution which contained in 100 ml 15 g sucrose and about 2·2–2·5 g CaO. For its preparation we used

[1] *Cistenie repnej st'avy* (Bratislava, 1950).
[2] *Voprosy tekhnologii sakharistych veshchestv.* (Moscow, 1950.)
[3] *Sucr. Belge*, 1938/39, **58**, 22, 70, 90.
[4] *Sucr. Belge*, 1949/50, **69**, 73; *I.S.J.*, 1951, **53**, 288.
[5] U.S. Patent 2,610,929 (1951); *Proc. IX Congr. Ind. Agr.* (Rome), 1952, 4.
[6] *Zeitsch. Zuckerind*, 1959, **9**, 557; *I.S.J.*, 1960, **62**, 103.
[7] KOHN *et al.*, *Chem. Zvesti*, 1958, **12**, 163.
[8] *Koagulácia v repnej st'ave*, Dissertation, Chemicky ustav SAV, Bratislava 1959; *Listy cukr.*, 1961, (in press).
[9] *Vliyanie kolloidov na protsessy sakharovareniya*, (Kiev, 1950).

burnt marble. (For the progressive predefecation we used a lime sucrate solution instead of milk-of-lime so that the coagulate of sugar beet juice colloids should not contain particles of undissolved $Ca(OH)_2$.)

The sedimentation of mud particles in the field of centrifugal force was followed with the aid of a Chirana centrifuge, which had a hydraulic revolution counter, and for great centrifugal acceleration with the aid of a Janetzki centrifuge, which had an electromagnetic revolution counter up to 20,000 r.p.m.

The density of the hydrated mud particles was calculated from their volume which was determined by the indicator method and from the densities of the thickened mud suspension and the clear predefecated juice, determined by pycnometer.

Colloido-chemical analyses were made—unless otherwise stated—at the laboratory temperature. Solution temperatures adjusted by means of a Wobser ultra-thermostat. For other details see below.

Determination of volume and shape of hydrated mud particles of progressively predefecated juice

Coagulated sugar beet juice colloids together with the precipitated insoluble lime salts of inorganic and organic acids form the basis of mud particles of predefecated juice. As we are concerned with a coagulate of typically hydrophilic colloids, such as proteins and pectins, it is necessary to take into consideration their hydrate envelopes when determining the volume of suspension particles.

A number of methods have been proposed for the determination of the volume of hydrated particles of colloid solutions or suspensions, and were described in a short review in our previous paper[10]. Of these, the most suitable are the so-called indicator method and the conductimetric method. The total volume of particles can be determined by both methods; this includes their hydrate envelopes, since the water which is bound to the particles by adsorption loses its function as a solvent.

The Indicator method.—We have developed a suitable modification of the indicator method for the accurate determination of the volume of hydrated mud particles of predefecated sugar beet juice[10]. Out of several different indicator substances the most suitable as indicators were chloride ions. We showed that during analysis there was neither adsorption of Cl^- ions on mud particles nor destruction of the hydrate envelope of particles by addition of electrolyte to such an extent that the exactness of the analysis would be endangered. (The mud suspension itself already contains a sufficient quantity of electrolytes.) The determined volume of hydrated mud particles was constant within the range of experimental error whatever the concentration of the indicator in the suspension[11]; ($\Delta V = 2\%$). The relative error of analysis was $\pm 2{\cdot}5\%$ on average.

Conductimetric method.—Of a number of papers[12] dealing with the volume determination of solvated particles of dispersion systems by the conductimetric method, we mostly relied on papers by FRICKE [13, 14, 15].

FRICKE dealt with the study of dispersal system conductivity, where the dispersed phase was of particles of spherical shape as well as rotating ellipsoids of widely varying types. By mathematical analysis[13] he deduced the equation:

$$\frac{\frac{k}{k_1} - 1}{\frac{k}{k_1} + X} = \varphi \frac{\frac{k_2}{k_1} - 1}{\frac{k_2}{k_1} + X} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where φ=the total volume of particles in the volume system unit (volume concentration of particles) k=electric conductivity of suspension, k_1=electric conductivity of dispersion medium, k_2=electric conductivity of particles (spheroids), X=correction factor dependent on the shape of particles. Factor X is a function of the ratio $\left(\frac{k_2}{k_1}\right)$ and of the ratio of the rotating ellipsoid axes (a/b).

$$X = f\left(\frac{k_2}{k_1}, \frac{a}{b}\right), \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

This complicated function is shown in Fig. 1 ($a \geqslant b$; rotating ellipsoids of elongated shape) and in Fig. 2 ($a \leqslant b$; rotating ellipsoids of lentil shape).

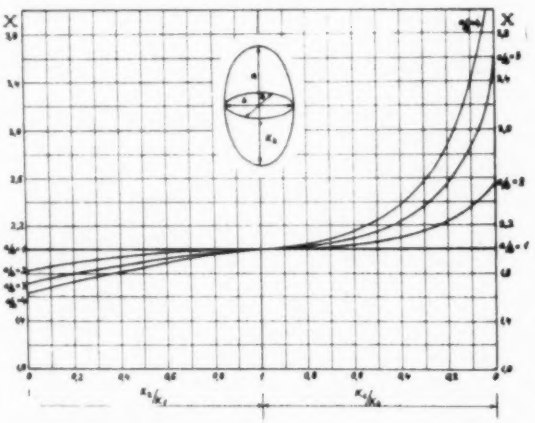


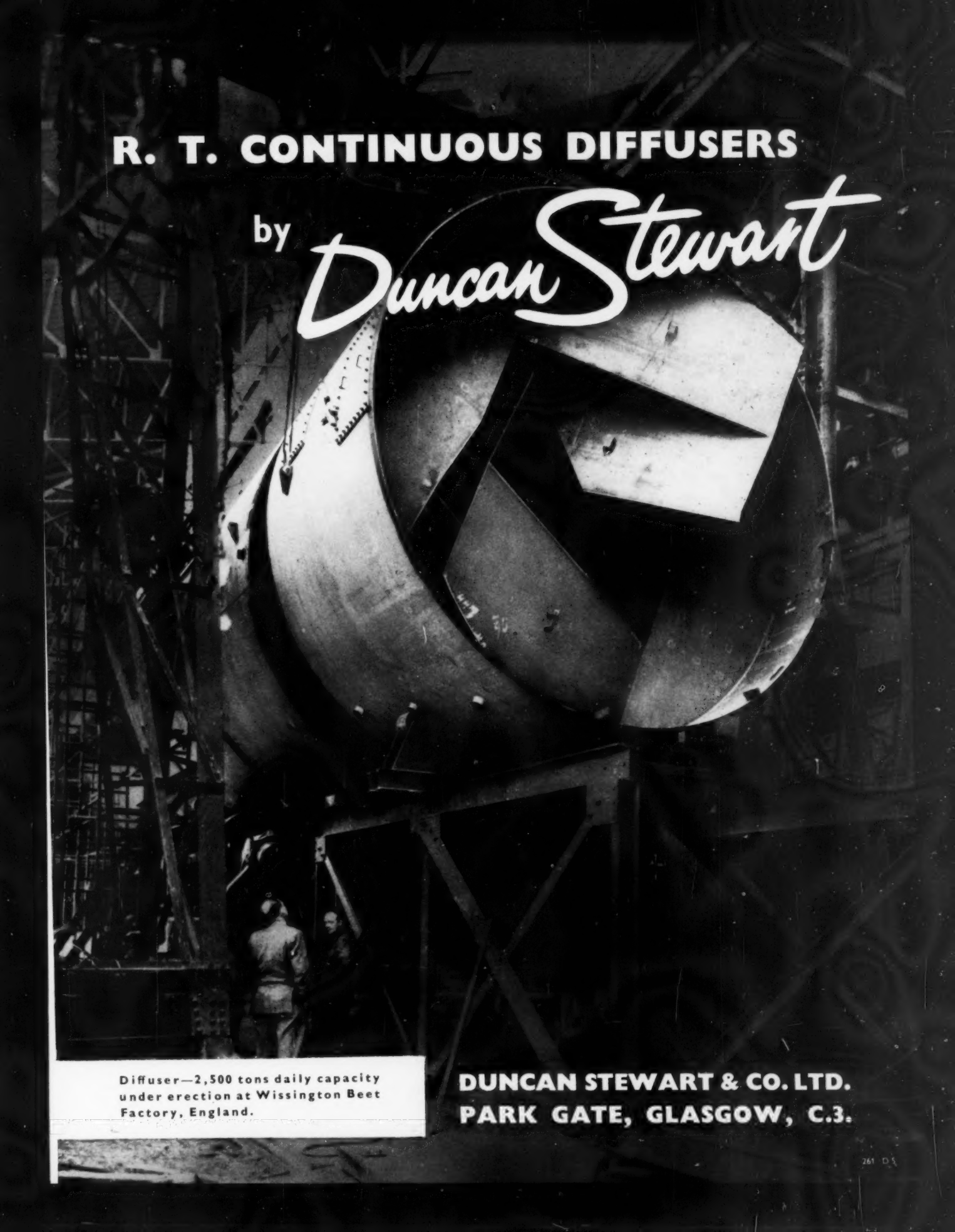
Fig. 1

The function dependency of factor X on the half-axes ratio of the rotating ellipsoid $\frac{a}{b}$ and the quantity ratio $\frac{k_2}{k_1}$ and $\frac{k_1}{k_2}$ for $a > b$.

Abscissae : $\frac{k_2}{k_1}$ and $\frac{k_1}{k_2}$

Ordinates : factor X for $\frac{a}{b} = 1$; $\frac{a}{b} = 2$; $\frac{a}{b} = 3$; $\frac{a}{b} = 4$.

[10] KOHN: *Chem. Zvesti*, 1961, **15**, (2), (in press).
[11] KOHN and KOHNOVÁ: "*Struktúra koagulovanych koloidov repnej st'avy*". Záverecná zpráva, Chemicky ustav SAV, (Bratislava, 1959).
[12] DUMANSKII : "Kolloidy v pishchevoi promyshlennosti", vol. 2, (Moscow, 1949). p. 8.
[13] *Phys. Rev.*, 1924, **24**, sec. ser. 575.
[14] *ibid.*, 1925, **25**, sec. ser. 361.
[15] *J. Phys. chem.*, 1955, **59**, 168.



Diffuser—2,500 tons daily capacity under erection at Wissington Beet Factory, England.

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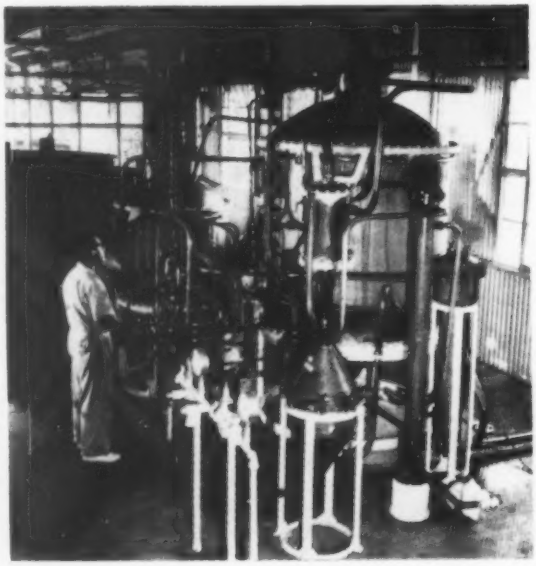

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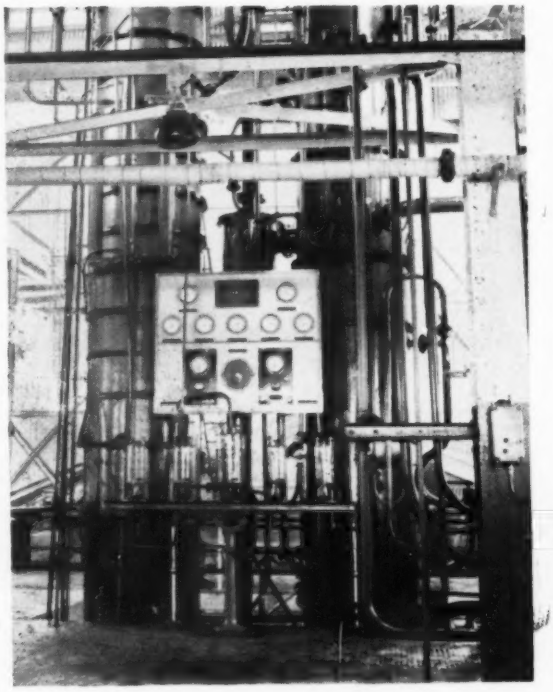

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By the conductimetric method it is possible to determine the quantity φ accurately without affecting the state of the hydrated particle envelope.

From the equations and diagrams above, it is obvious that with the aid of this method it is possible to ascertain also the approximate shape of spheroidal particles. If the quantities k, k_1, k_2, and φ are known we can calculate from the equation (1) the value of factor X, which characterizes the shape of the rotating ellipsoids. The volume concentration of particles φ must be determined in a different way, however, which must be independent of the conductimetric method,

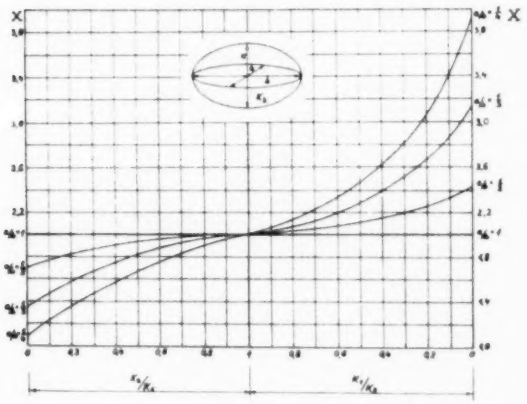

Fig. 2

The function dependency of factor X on the half-axes ratio of the rotating ellipsoid $\frac{a}{b}$ and the quantity ratio $\frac{k_2}{k_1}$ and $\frac{k_1}{k_2}$ for $a \leqslant b$.

Abscissae : $\frac{k_2}{k_1}$, and $\frac{k_1}{k_2}$

Ordinates : factor X for $\frac{a}{b} = 1$; $\frac{a}{b} = \frac{1}{2}$; $\frac{a}{b} = \frac{1}{3}$; $\frac{a}{b} = \frac{1}{4}$

e.g. by the indicator method. The calculated factor X shows whether the particles are spherical or anisometric. Further it is necessary to determine in another way if anisometric particles resemble rotating ellipsoids of spindle shape (Fig. 1) or ellipsoids of lentil shape (Fig. 2).

The determination of factor X

φ was determined by the indicator method. Electrical conductivity of mud suspension k and of the clear dispersal medium k_1 was measured in an apparatus described by FRICKE[14]. As the volume concentration of hydrated mud particles in the predefecated sugar beet juice is very small we took for analysis (as when determining φ by the indicator method) predefecated mud, thickened 15 to 20 times by sedimentation and centrifuging. The measured values we recalculated to the original mud suspension. The thickening of mud suspension by centrifuging as well as the separation of the clear dispersal phase was done in closed vessels. The solutions and suspensions were protected during analysis by an atmosphere of nitrogen to eliminate fortuitous absorption of aerial CO_2. Electrical conductivity was measured with the aid of a modified commercial conductimeter of relatively high precision.

The determination of electrical conductivity of hydrated mud particles k_2.—The quantity k_2 can be determined indirectly with the aid of the equation (1) if quantities k, k_1, φ, and X are known. The exact determination of k_2 is not a simple task, as factor X is a function of the ratio $\frac{k_2}{k_1}$. It therefore should be necessary to determine φ and X independently of the conductimetric method.

It was possible to accomplish the direct determination of k_2 sufficiently accurately in the following manner: we measured the electrical conductivity of mud suspension and the clear dispersion medium in the original thickened mud suspension (k, k_1) as well as in the thickened suspension, the electrical conductivity of which was then raised 4 to 6-fold (k', k_1') by adding KCl. In both cases was the volume concentration of particles of the suspension equal.

By substituting values k, k_1 and k', k_1' in equation (1) we get a system of two equations, where the unknowns are k_2, φ and X. By the indicator method it has been proved that for chosen concentrations of electrolyte in the suspension the quantity φ is practically constant. (After adding 0·3 equiv. KCl/1000 ml $\Delta\varphi = -2$ to -3%). As the electrical conductivity of mud particles was shown to be small $\left(\frac{k_2}{k_1} \leqslant 0{\cdot}05\right)$, we can, for the purposes of calculation, consider factor X for both systems to be constant. For X we substituted the average of six determinations; $X = 0{\cdot}73 \pm 0{\cdot}03$ (see below). Solving these equations for unknowns k_2 and φ we get a quadratic equation from which we can calculate the value of electrical conductivity of mud particles k_2 (for particulars see [11]).

The electrical conductivity of mud particles determined by the above-mentioned method, reached on average about 5% of the electrical conductivity of the clear dispersion medium, i.e. of the clear predefecated juice. If we accomplish the determination of φ in the suspension by adding electrolyte (e.g. 0·2 to 0·3 equiv. KCl/1000 ml) and consider the mud particles as electrically non-conducting, the error in the calculation of φ will be roughly -1%.

The volume concentration of mud particles φ was determined by the conductimetric method in the original thickened mud suspension as well as in the suspension after adding electrolyte. The electrical conductivity of mud particles was always taken into account in the analyses.

The relative error of determining quantity φ by the conductimetric method was, when the value of factor X was known, on the average $\pm 2{\cdot}5\%$.

(*To be continued*)

Technical advances in the sugar industry and its by-products utilization. A. L. MAZUMDAR. *Indian Sugar*, 1960, **10**, 327–332.—Certain developments in cane agriculture and the cane sugar factory during the twentieth-century are briefly discussed, and mention made of the utilization of bagasse, final molasses, and filter muds.

* * *

In South Africa: recent trends in sugar manufacture. C. G. M. PERK and K. DOUWES DEKKER. *Sugar J.* (La.), 1960, **23**, (5), 13–16.—A general picture is given of the processes in the Natal factories and of the various changes that have been brought about in recent years. These include expansion of mill and boiler capacity, clarification without sulphur or phosphoric acid; use of the double-magma boiling system instead of the straight three strike scheme; and the addition of refining sections to existing raw sugar factories.

* * *

A report from Mauritius: useful information on milling methods. R. B. L. MATHUR. *Sugar J.* (La.), 1960, **23**, (5), 21–24.—The milling techniques used in Mauritius mills are described, in particular giving details of cane preparation, cane carriers, feeder rolls, mill groovings and milling efficiencies.

* * *

Increasing existing mill capacity. L. A. R. PINTO. *Sugar y Azúcar*, 1960, **55**, (10), 36–38.—The following are suggested to increase mill capacity: "chevron" grooving in top and feed rolls, with a minimum pitch of $\frac{3}{4}$ in at an included angle of 50–55° to increase pull, and permit better drainage; fitting of feeder rollers; provision of Messchaert grooving and/or double pitch on the feed roll, which should be supported by a floating shaft driven by the top roll; the use of a single set of knives of small pitch, which will penetrate deeply into the cane blanket, and one shredder; a maximum roll speed of 6 r.p.m. to avoid slipping; replacement of steam engines with turbines. At Usina Sta. Lydia (Brazil), the classic system of crusher feed using a steep and long chute was replaced by a system in which the variable speed cane carrier feeds an intermediate carrier of constant speed and driven by and feeding the crusher. By introducing certain of the above-mentioned modifications over a number of years, the mill capacity has been raised from 23 to 42 tons/hr.

* * *

Drives for fully-automatic centrifugals with electrical charging by energy measurement. H. HINZ. *Zucker*, 1960, **13**, 535–539.—The automatic controls on a centrifugal at Frellstedt refinery are described. The flat-bottomed machine has a capacity of 650 kg, and handles 22 charges per hr at a discharge speed of 50 r.p.m., a charging speed of 200 r.p.m., an intermediate speed of 720 r.p.m. and a maximum speed of 1470 r.p.m. The motor speed is controlled by an electrical time-speed control with a time relay control for 0·3 sec to 6 hours. A maximum speed within the range 1000–1500 r.p.m. is possible through the speed control. Details are given of the feeler mechanism already described[1]. A constant charging speed may be maintained by a means other than the feeler, i.e. by measurement of the momentum of the basket during charging, which is increased with increase in the amount of massecuite in the basket, which rotates at constant speed. Thus there is no danger of the gate valve closing when less than the required amount of massecuite is in the basket, as with time control. The centrifugal can handle 27 and even 30 charges/hr now that the motor has been equipped with a thermo-contact.

* * *

Study project on the exhaustion of final molasses. M. A. MASCARÓ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 37–38.—The inadequacy of both apparent and true purities as indicators of the exhaustion of molasses is discussed. The DE MICHELI & GYULAY formula[2] compares the exhaustion achieved in the factory with that which would be obtained in a well-equipped and managed factory; the author suggests that a better criterion would be the purity achieved in a laboratory test using the factory's exhausted molasses which would be kept in contact with seed crystals until it reached the lowest possible purity.

* * *

Exhaustion of molasses. J. R. DE LA VEGA and M. A. MASCARÓ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 39–43.—During the boiling process, sucrose in the syrup reaches saturation and then crystallizes. The concentrations of the non-sucrose constituents also rise and reach saturation, after which they co-crystallize with the sucrose, lowering its purity. The purity of the sugar produced however, does not suddenly drop so that there is no point of inflexion which can be taken as the stage when the molasses is exhausted. However, glucose, a major non-sucrose impurity, has a solubility of the same order as that of sucrose; consequently the molasses may be considered exhausted when glucose starts to co-crystallize with the sucrose.

[1] *I.S.J.*, 1958, **60**, 331.
[2] SPENCER & MEADE: "Cane Sugar Handbook", 8th Edn. (Wiley, New York.) 1945. pp. 223–4.

Economic aspect of the exhaustion of final molasses. M. ANDUX. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 45–50.—Under conditions whereby the crop is restricted by decree and there is a strong demand for molasses, the majority of sugar factories buying cane under Decree Law No. 1274 will find that poor exhaustion of molasses is more profitable than good exhaustion, and that the cost of new equipment for improving exhaustion cannot be amortized. On the other hand, factories buying cane by weight at a flat rate, and those crushing their own estate cane will find it more profitable to exhaust their molasses completely and improve sugar yield.

* * *

Cleaning the outside of calandria tubes (Dittmar Process). S. VIEGO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 51–54.—Various means of cleaning the steam side of calandria tubes are described and an account given of the Dittmar process and costs involved. A hot (100°C) alkaline solution of potassium permanganate (2·5% NaOH; 1·5% $KMnO_4$) is circulated through the calandria for 8–15 hours as indicated by the appearance of a sample of badly scaled tube held in a small tank supplied by the same circulating solution. Sodium carbonate (2·5%) is added to the solution to maintain the alkalinity during the circulation. After the alkaline treatment, a 2·0% solution of hydrochloric acid is circulated until the tube sample is clean "to the copper". Total material costs work out at 0·027 pesos per sq. ft. of tube surface.

* * *

Sealed boiling tubes. A. L. WEBRE. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 55–61.—The principle of the sealed-tube evaporator is briefly discussed and its operation examined by means of a materials and heat balance drawn up for a 20,000 sq. ft. quadruple effect unit. The importance of heating the juice to its boiling point before feeding to the first effect is mentioned, and attention drawn to the great difference in velocities of juice and vapour through the tubes. Because of this, the effective speed of the juice through the tubes is high, leading to more efficient heat transfer and less scaling, while the fact that it is in the form of a foam means that no liquid may be seen in the level indicators. Mention is made of the effects of hydrostatic pressure which may result in boiling point elevations of 2·0 to 12°F in the 1st to 4th effects. High vapour and juice velocities have been associated in the past with entrainment, but very efficient separators are now available which will avoid this. The importance of even juice feed distribution is emphasized since this is necessary to good results.

* * *

Molasses purity in a massecuite. F. GARCÍA LÓPEZ and J. A. CLARK. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 63–79.—A series of graphs are presented for use in calculations of molasses purities which may be derived from massecuite data. They include curves for the relationship between purities (true and apparent) and concentrations for saturated molasses at various temperatures; conversion of apparent to true purities and of Brix to solids by drying; the relationship of concentration with molasses purity at 150°F and at various degrees of supersaturation and impurities/water ratios; and the same relationship at varying temperatures, supersaturation and impurities/water ratio. Progress of a strike in a pan and in a crystallizer are discussed by reference to these graphs and a number of problems worked out with their aid, e.g. calculation of supersaturation of a strike and the minimum molasses purity obtainable if it is purged at a particular temperature. Factors which limit, retard or hinder crystallization are listed and briefly discussed, as is the importance of the impurities/water ratio.

* * *

The advantages of strikes of high Brix. J. A. CLARK and F. GARCÍA LÓPEZ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 81–87.—To make a theoretical study of the effect of adopting the Plaistow Wharf technique of heavy boiling in raw sugar manufacture, calculations have been made of five variations in the usual three-massecuite system and two variations of the two-massecuite system, in which the A-strike dropped at 1·25 supersaturation is boiled to 89·5, 90·5, 91·5, 92·5 and 93·5 and 93°Bx respectively, the B-strike boiled to 90·5, 92, 93, 94 and 95°Bx for the three-massecuite system, and the C-strike boiled to 1·50 supersaturation and 93, 94, 95, 96 and 97 and 96 and 97°Bx respectively. From the calculated data it is concluded that whatever the boiling system, there will be an increase in sugar yield and decrease in molasses formation, an increase in pan capacity (and so milling capacity), a reduction in steam and water consumption in the pans. Where the A- or B-molasses is of a purity 2–3 units lower than that required for the final strike, it should not be used to make a further massecuite of lower purity but should be incorporated in the final strike.

* * *

The liming tank. G. ALEMÁN HIDALGO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 99–105.—The importance of correct and adequate liming in the cane sugar factory is emphasized, and the reduction of clarification difficulties, compared with former times, is attributed largely to better and more uniform liming which has resulted from application of instruments and automatic control. Requirements for a liming tank to operate under optimum conditions are discussed and a tank design illustrated which, although not perfect, has given very good results for a number of years as shown by the limed juice pH indicator charts which are reproduced.

* * *

System of double-liming and double heating of juice at Central Violeta. T. FANDIÑO LÓPEZ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 107–114.—In the system adopted in 1958, juice is heated to 150°F,

limed to pH 6·0–6·4, heated again to 230°F, passed through a flash tank, and then limed to pH 7·6–8·0. A sample is withdrawn continuously and passed through a water-cooled copper coil before passing to a pH recorder/controller, which is connected to the milk-of-lime feed at the secondary liming. The process gives a clear juice of Luximeter reading 40 (compared with 25 for the former double-liming single-heating process) of pH 6·9 (7·3) and better filtrability, colour and ash.

* * *

New process of clarification. A. COSSON, T. R. HELLESNESS and J. R. DE LA VEGA. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 115–119.—Oliver rotary filter treatment of clarifier muds yields a juice containing suspended particles. Experiments have been carried out on the clarification of such filtrate using a De Laval separator type PX 209–30S. Simple passage of filtrate yielded a turbid liquid of slightly higher purity (78·52 *vs.* 78·15). It was found better to lime the muds to pH 7·2–7·5 before passing to the Oliver filter; the filtrate purity was then increased by 0·51–0·80 units on centrifuging, depending on the throughput. By reducing the suspended solids returned to clarification in the filtrate, the clear juice solids were reduced by 50% only 6 hours after starting the process; after 13 hours the clear juice and centrifuged filtrate both had solids contents 75% less than that originally in the clear juice.

* * *

Preclarification of juice in acid medium. II. J. R. DE LA VEGA, M. A. MASCARÓ and C. PÉREZ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 121–128. Continuing laboratory experiments described previously[1], factory scale trials were made using a 2000-gal clarifier at Central Habana. Mixed juice at 27–30°C was injected with gaseous SO_2 sufficient to bring the pH to 3·6. Examination of the settling velocity showed that retention time in the clarifier would not be more than 1¼ hr to bring the mud volume to 25% of the total volume; in this time the purity falls by 0·2 units—the theoretical amount (calculated from the laboratory results) on the day after cleaning—but rises later to 1·8 units, of which 0·4 units is due to microbiological action. Bacterial counts are tabulated as well as data from the trial runs.

* * *

Crystallization of exhaustion strikes using powdered sugar. P. HONIG and F. DE MIGUEL. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 129–140.—Descriptions are given of techniques used in various parts of the world where the use of powdered sugar for final strike seeding has been adopted. It is recommended that the sugar be powdered in a "Minimill" ball mill, using petrol, *iso*-propyl alcohol or 99·5% ethyl alcohol as the organic fluid medium, continuing the milling until a uniform suspension of sugar particles of 3–5 microns average size is obtained. The seed should be built up using a supersaturated syrup of 70–75° purity, and proper circulation and degree of supersaturation should be maintained. A method of calculating the quantity of powdered sugar necessary is described and an example worked.

* * *

Technological progress in Cuba. J. C. GONZÁLEZ MAÍZ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 147–154.—A brief review is given of new equipment and techniques adopted recently in Cuban factories; they include the "San Juan" mill couplings, sealed downtake evaporators, the 2½-massecuite boiling system, crystallization and juice clarification systems, and the automatic control of pans and evaporators.

* * *

Installation of gears. J. C. TARAFA. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 155–164.—The importance of correct gear alignment to prevent wear is discussed, and a table is presented showing the backlash necessary to allow for metal expansion with increasing temperature. A technique is described by which the gears can be tested for alignment using a red lead paste. This leaves marks on the gear surfaces which are characteristic, and typical patterns obtained with various types of misalignment are illustrated.

* * *

The energy of the sugar cane. E. A. VAZQUEZ. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 165–178. Comparative costs are worked out for the production of electricity by combustion of sugar cane and oil, and for nuclear power generation; the former is cheaper whether or not sugar or alcohol is produced as well.

* * *

Lubrication of mill roll journals. U. VILLAR LORENZO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 177–188.—The economic importance of satisfactory mill lubrication is discussed. Conditions at the bearing which result from the heavy loading are of the "limited lubrication" type, where viscosity of the lubricant is not important, in contrast with its chemical composition and the condition of the metal surfaces. The lubricant forms a "molecular layer" which, to avoid damage, must not be broken with resulting metal/metal contact. Factors affecting roller/shaft lubrication are discussed, and a number of causes of lubrication difficulties are listed.

* * *

How to improve and make economies in the lubrication of mill roll journals. U. VILLAR LORENZO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 189–201. Forced feed mechanical lubrication is considered to be the safest and most effective and economical system to employ with mill roll journals. To prevent contamination of the lubricant with cane juice, bagacillo and water, etc., a copper cap should be placed on the roll shaft and juice guards on the bottom rolls should be enlarged. Adoption of the "San Luis" system of forced-feed lubrication has

[1] *I.S.J.*, 1959, **61**, 209.

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reduced lubricant consumption from 3 lb to 1 lb per day. It is confirmed in practice that in conditions of "limited lubrication", the quantity of lubricant necessary is the same for different crushing rates, other conditions (load, number of bearings, etc.) being equal.

* * *

The problem of increase in milling costs. A. B. CHIRGWIN. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 203–206.—Cf. *I.S.J.*, 1959, **61**, 271.

* * *

Automatic control of bagasse consumption. J. J. MECSERY. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 207–218.—In cases where oil is used as a supplementary fuel or where surplus bagasse is used for manufacture of by-products, automatic control of bagasse combustion is of especial importance. The three types of control—intermittent, positioning and measuring—are described briefly. The last is considered the best. A detailed and illustrated description is given of a recent installation where a positioning type of control is applied to the air and bagasse supplied to a furnace, while application of the measuring type of control is also discussed. Application of control systems for furnaces without mechanical spreader-stokers is difficult but not impossible, but is limited to control of draught and of bagasse/air proportion. It is important to regulate boiler water feed and level automatically as part of the furnace control to ensure that the benefits of the latter are not lost.

* * *

Entrainment separators in evaporating plant. J. DIAZ COMPAIN. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 219–223.—The "Separador D.C.", an entrainment separator, designed to be efficient, economical to construct and easy to instal, is described and illustrated. It was installed on the fourth, and, later, all the vessels of a quadruple-effect evaporator, eliminating all entrainment and producing condensate which was of pH 7–8·6 (slightly alkaline because of the dissolved ammoniacal gases) and needed no conditioning to bring it to a satisfactory pH for boiler feeding. In a second factory experiencing entrainment trouble, the separator was installed on one of the two quadruple-effect evaporators; entrainment in this evaporator was completely eliminated.

* * *

Prevention of entrainment from the syrup vessel of a quadruple effect (evaporator). U. VILLAR LORENZO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 225–232.—The effectiveness of an entrainment separator depends on its design and also on the vapour velocity which should be nearer the lower of the limits of 100 and 200 f.p.s. At Central Zaza, the separator used up to 1957 was replaced by a centrifugal type designed to lower the velocity from 212 to 125 f.p.s.; in addition, the height of the vessel has been increased; experience has shown the importance of the distance between separator and top tube plate, which should not be less than 1½ times the diameter of the vessel.

Efficient milling control. M. A. SUÁREZ CARREÑO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 233–243.—Milling efficiency is usually judged on the basis of final bagasse analysis, i.e. on the results of the tandem as a whole. It is proposed that the operation should be considered in two stages: mechanical expression of primary juice in the first mills, and lixiviation of residual juice in the succeeding mills where maceration and mechanical separation are combined. Both stages are treated in detail and factors affecting each are discussed; their relation with the milling capacity of the tandem is also mentioned. Recommendations are made for improving milling.

* * *

Causes of difficulties with boiler water. A. FAJARDO. *Mem. XXXII Conf. Asoc. Técn Azuc. Cuba*, 1958,. 245–249.—The various sources of raw water and the common difficulties occuring with their use are discussed, together with appropriate preventive measures.

* * *

Cane shredding knife. R. A. PONCE DE LÉON. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 251–261. Across the end of each blade of a standard cane knife set is fitted a second blade having two hyperbolic cutting surfaces meeting at a point in the form of an arrow-head. The action of the knives is augmented by a rotating feeder shaft mounted across and close to the carrier just outside the knife periphery; this carries a series of plain or toothed plates which lift the cane blanket so that the angle of entry of the arrow-head is improved. The depth of the blanket is divided into "optimum", "good", "poor" and "mill" zones, the last being close to the carrier. With normal cane knives, it is possible for whole cane to pass underneath the knives (in the "mill" zone); the feeder shaft lifts the whole of the blanket into the "good" and "optimum" zones so that all the cane is shredded and mill working consequently improved.

* * *

Sugar unloading system's rotary dumper rolls railroad cars up 30-degree incline. *Link-Belt News*, 1960, **27**, (6), 1, 5.—The raw sugar bulk unloading system at the Philadelphia refinery of the National Sugar Refining Co. is described. Raw sugar is unloaded from ships by gantry cranes and is automatically weighed in hoppers before discharge to rail cars for transport to refinery sidings, 2·7 miles away. The sugar is unloaded to a receiving hopper by means of a rotary car dumper constructed by The Austin Company. While the car is rotating through 150° from the vertical it also rolls up a 30° incline to a position over the hopper. After unloading, the switch handle is reversed manually, the dumper accelerates until within abour 15° of its starting position, when speed is reduced to half. At this speed the dumper continues until the level track limit switch on the dumper girder is tripped and rotation stops. The dumper is held in place by a spring-set brake, and may be stopped at any time through a master switch.

Jute as a filter fabric in sugar mills. A. M. SHAIKH and M. AHMED. *Pakistan J. Sci. Ind. Res.*, 1959, **2**, 27–29; through *S.I.A.*, 1960, **22**, Abs. 918.—Factory tests on the filtration of carbonatated cane juice with jute canvas filter cloth, in comparison with cotton twill, are reported in detail. The jute is much cheaper. The cake tends to stick to the hairy surface of the jute canvas, and the pores tend to widen owing to separation of fibres, and failure at the edges of the frame results in poorer durability of the jute than of the cotton fabric. Jute, in its present form, is best used as a backing for cotton twill.

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Sugar at 10 hundredweight a minute. P. M. SANDERS. *Mechanical Handling*, 1960, **47**, 588–596.—The automatic packaging and parcelling system at Wandle Wharf, the Wandsworth (London) station of Tate & Lyle Ltd., is described with illustrations. Granulated sugar transported from the refineries in 13-ton end-tipping road tankers is emptied straight into an underground 21-ton storage hopper and is carried thence by belt conveyors to one of four 5-ton hoppers feeding the Hesser packaging machines. The weighing and parcelling machines and the continuous system for loading and delivery vehicles are also described. The sugar is entirely untouched by hand throughout the station.

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Determination of the efficiency of final product massecuite crystallization. K. WAGNEROWSKI, D. DABROWSKA and C. DABROWSKI. *Gaz. Cukr.*, 1960, **62**, 265–272.—Details are given with graphs of the crystallization of 3rd massecuite at Janikowo sugar factory. These demonstrate the effect of moisture content of the massecuite on the crystallization efficiency, the dependence of sugar losses on the cooling of the massecuite and of the temperature of the final crystallization on the extent of dilution of the massecuite. Graphs are also given of the course of crystallization at supersaturation coefficients of 1·0 and 1·1. Sugar losses in molasses were 0·3% on beet. This figure is attributed (1) to inadequate thickening of the massecuite caused by the dropping of thin strikes into the crystallizer and by supplementary dilution of the massecuite by condensate from the pans, and (2) to insufficient cooling of the massecuite. It is recommended that the massecuite be cooled to 45°C during 58 hr, a strike being dropped every 6 hr.

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The performance of milling trains. Some theoretical considerations. K. DOUWES DEKKER. *Proc. 10th Congr. I.S.S.C.T.*, 1959, 86–99.—The three operations included in milling, viz. opening of juice-containing cells, juice-fibre separation, and dilution of residual juice, are considered separately. Proper preparation of cane, with the maximum number of cells broken, is essential, as is adequate mixing of the imbibition liquid with residual juice. The importance of the volumetric coefficient—lb fibre/cu. ft. escribed volume—and reabsorption are discussed, with reference to performance data from Java, where the optimum volumetric coefficients used were 35 lb and 55 lb fibre/cu. ft. escribed volume for 1st and last mills. Using these coefficients and reducing absorption by removing the maximum amount of juice with top and front rollers and selecting suitable grooving will help towards attaining maximum mill performance. The separating effect of a mill is best indicated by the fibre % discharged bagasse, and, to a lesser extent, by the bagasse moisture content. Pol or Brix data are unnecessary, as they are largely influenced by the mixing of the imbibition liquid and residual juice. A scheme for calculating milling performance is appended. It is thought that the number of opened cells increases linearly with the amount of juice squeezed out.

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Reabsorption a limiting factor in mill performance. W. R. CRAWFORD. *Proc. 10th Congr. I.S.S.C.T.*, 1959, 100–111.—Reabsorption is discussed theoretically and with experimental data as a basis. EGETER's hypothesis[1] of forward juice flow relative to the blanket is only partially correct, as backward displacement of the pressure peak, which precedes reabsorption, must be the result of some cause such as blanket extrusion. The onset of reabsorption with increasing pressure does not preclude increased extraction, although with a free-floating top roller, a point is reached after which extraction falls with increasing pressure. At this point a minimum amount of juice is lost and hence we have maximum extraction. Low fibre canes have been found to suffer from low losses due to reabsorption, and *vice versa*. There is less absorption with finely prepared cane.

* * *

Extraction as a function of roll load in the two-roller experimental mill. K. J. BULLOCK and C. R. MURRY. *Proc. 10th Congr. I.S.S.C.T.*, 1959, 111–112.—Experiments conducted on the inter-relationship of juice extraction with speed, compression ratio, preparation and roll load using the Queensland University 2-roller mill are reported. If the roll load is increased by increasing the compression ratio, the extraction rises at a rate which is greater at lower compression ratios. If the roll load is increased by decreasing the speed, the extraction rises when juice grooves are cut in the lower roll. If the roll load is increased by using coarser preparation, extraction falls except at low compression ratios where a small increase occurs. If roll load is increased or decreased by changing feed depth or work opening, the extraction increases or decreases to a greater extent at medium preparation and less at coarse preparation. Use of juice grooves in the investigation appeared to result in a drop in extraction at a particular roll load.

[1] *Archief.*, 1928, **2**, 691.

Influence of the CaO degree of utilization on the economy of a sugar factory. H. EIGEN. *Zeitsch. Zuckerind.*, 1960, **85**, 525–530.—The degree of CaO utilization is defined as the ratio of the basic CaO determined in the factory as juice alkalinity to the CaO in burnt limestone. It may drop to 65% in the case of poor lime burning, or climb to 95% in a good lime station. The corresponding costs of limestone and coke will lie between DM 0·65 and 1·20 per ton of beet or between DM 4·92 and 9·09 per ton of white sugar. The various factors involved in determination of a lime station efficiency are discussed, including kiln thermal efficiency, the amount of CO_2 obtained per ton of limestone, quantity balances of the kiln and slaking plant and complete CaO balances for the whole lime station. A kiln charging device for an induced draught shaft lime kiln is described, which ensures good mixing of the limestone and coke through a low charging height of only 50–80 cm, instead of the usual 2–3 m. The advantages of this are enumerated.

* * *

Effect of the introduction of formalin during diffusion on certain characteristics of purified sugar juices. J. STAMBUL and J. VETTER. *Ind. Alim. Agric.*, 1960, **77**, 653–654.—Because of coloration of beet juice when formalin was added to diffusion, tests were carried out in a laboratory beet juice plant, in which the diffusion juice from healthy beet was limed and carbonatated as usual, and the juice analysed for density, lime salts content, conductimetric ash, and colour content. It was found that when formalin was added to the diffuser, the second carbonatation juice purity was reduced from 93·30 to 92·55. An increase in colour as noticed when formalin was used, the ratio of colour increase : Brix being greater than of colour increase: non-sugars. When the formalin was added hot the increase in colour was greater. The colour increase is possibly due (1) to a condensation reaction between formalin or its polymers and the amino acids in the juice, or (2) to the inversion *in situ* of some of the sucrose in the presence of formic acid resulting from oxidation of formaldehyde and the degradation of the resultant hexoses in an alkaline medium.

* * *

Second carbonatation juice filtration with the Olier AKA filter. L. OLIER. *Zeitsch. Zuckerind.*, 1960, **85**, 537–539.—Tests with a 25 sq.m. Olier filter[1] are discussed. In 1958 it was found that the kieselguhr for the pre-coat must be of a certain determined nature; the juice may be filtered without this precoat in emergency, as the juice leaves a deposit very shortly after filtration is started. After a time, dependent on the amount of juice and the carbonate content, the filter must be stopped though the pressure drop varies only very slightly; otherwise, the equilibrium of forces is upset as soon as the cake on two neighbouring candles is disturbed and starts to crumble. In 1959 the filter was slightly modified and 137 filtration cycles were carried out throughout the campaign. Perfectly clear juice was obtained. The juice clarity was determined by the so-called "cross" method, whereby a cross consisting of two dissimilar arms is lowered into a brightly lit glass tube and the juice clarity given as the height of the juice at which the thicker arm of the cross is no longer visible. The effective height of the flask was 95 cm. Of 400 samples from cycles 1–92, 350 gave a height greater than 95 cm, 44 between 80 and 95 cm and 6 at various heights between 30 and 79 cm. Cycles 93–137 yielded 207 samples of greater than 95 cm "clarity" and 3 at 92, 91 and 82 cm. Filter press and bag filter juices had "clarities" of 80–85 cm. Filtration cycle time is 4 hr for a throughput of 100 cu.m./hr, the total carbonate content of the 400 cu.m. of juice being 1300 kg. Tests with a throughput of 150 cu.m./hr have proved as satisfactory. In sweetening-off, the sugar loss was 0·0068 kg/100 kg of beet at a sweetening-off water quantity of 2 litres.

* * *

Results of tests on thickening, storing and processing diffusion juice. P. YA. IVANOV. *Sakhar. Prom.*, 1960, (10), 26–28.—Tests were carried out with the aim of making possible increased throughputs without building new factories. The raw juice was evaporated to 65–68% dry solids, limed to 0·05–0·10% CaO, then stored in metal tanks of 3340 cu.m. total capacity for 90 and up to 150 days. Before processing, the juice was heated to 15–25°C then diluted with hot water and pre-limed as usual. Tabulated results reveal higher lime salts content, lower juice purity, higher juice and white sugar colour, higher molasses purity, higher losses and a 3% lower sugar yield. Fuel and lime consumption increased by 100% and the cost of one zentner of sugar rose by 70%. The juice should be diluted to 15–18% dry solids, i.e. the same as normal juice, but in this case fuel consumption would be double the normal.

* * *

Recovering sucrose as calcium trisaccharate from molasses solutions. P. V. GOLOVIN, A. A. GERASIMENKO and G. S. TRET'YAKOVA. *Sakhar. Prom.*, 1960, (10), 29–30.—Tests were conducted on molasses of 62·3 purity diluted with distilled water to 13·4% dry solids containing 8·41% sugar. It was cooled to 1–2°

[1] *Cf. I.S.J.*, 1961, **61**.

and freshly-calcined CaO in powder form added (115% on weight of initial sugar). The amount of sucrose precipitated in the form of Ca trisaccharate was 85% of theoretical when the molasses solution was not acidified (pH 7) and 87% if the pH were adjusted to 6 with HCl. Such a slight difference shows that the sucrose exists in a free state in the molasses and not as a salt compound as stated by DEDEK[1]. The sucrose yield was lower than would be precipitated from a pure sucrose solution because of considerable foaming, which prevented adequate contact between the lime and the solution. Lime quality, temperature and mixing are the major factors determining the sucrose yield.

* * *

Active ventilation of sugar beet in piles. P. N. SHEMYAKIN. *Sakhar. Prom.*, 1960, (10), 53–56.—The amount of air flow based on the required heat reduction and the ambient and inside temperatures is discussed. One ton of beet should be ventilated with at least 30 cu.m. of air per hour, and in the case of laterally placed air lines the figure should be 40 cu.m./hr.

* * *

First beet campaign in Pakistan. H. KAMPF. *Sugar y Azúcar*, 1960, **55**, (10), 33–34.—Beet slicing commenced in Pakistan at the Charsadda Sugar Mills in May 1960 after completion of the cane season. The beet end of the factory uses a DdS diffuser, and a modification of the de Haan double carbonatation-sulphitation used in the cane factory. Yield at 9·02% is higher than the 7·095% with cane processing. Sugar content of the beet averaged 14·67% (maximum 17·00%).

* * *

Effect of mechanization and automation on the productivity of the sugar industry. H. LAMOUCHE. *Soc. Ingén. Civiles Franç.*, 1959, **112**, (4), 233–253; through *S.I.A.*, 1960, **22**, Abs. 873.—The improvements in beet sugar manufacture since its commencement are reviewed. Big labour savings resulted from the discontinuation of separate weighing and raspi..g stations for raw juice manufacture, and also from improvements in transport, washing and handling methods. Continuous diffusion also gave big savings, owing to reduced sugar losses. The RT, DdS and Olier systems and their methods of control are briefly described. The Dorr-Oliver juice purification system is also reviewed. An example is given of the reduction in fuel consumption obtained with an automatically regulated turbo-compressor system for the evaporators (flow-sheet provided). The supersaturation during boiling can be controlled automatically from measurements of the conductivity. The sugar centrifuging operations are also controlled automatically. A diagram is given of the Arca system of regulating the high-pressure boilers which have to respond to the fluctuating energy demands of the factory.

Decolorizing ion-exchangers, their properties and their use in the sugar industry. J. ŠTAMBERG, V. VALTER and Z. MENCL. *Chem. Technik*, 1960, **12**, (1), 32–36; through *S.I.A.*, 1960, **22**, Abs. 883.—Laboratory and pilot-plant tests of the decolorization of beet thin and thick juices and refinery liquor, and later factory-scale decolorization of refinery liquor, are described. Weakly basic or amphoteric resins may be used for nearly neutral juices, but for strongly alkaline liquor a strongly basic resin is necessary. The weakly basic resins were regenerated with alkaline ammonium chloride and then activated with HCl; owing to the acid activation the filtrates were at first very clear, but the colour increased with alkali break-through. Results are shown in graphs. The factory results were better than those on the small scale. The capacity of the resins gradually decreased, probably owing to the effect of the hot alkali. The decolorization process with resins is however cheaper than with activated carbon.

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The performance of predefecation units. B. NOWAKOWSKI. *Gaz. Cukr.*, 1960, **62**, 272–277.—Details are given of the alkalinity of prelimed juice and 1st carbonatation juice and of the filtration coefficient F_k at various temperatures in different predefecation equipment used by certain Polish factories. Some factories use progressive co- and counter-current preliming, some instantaneous preliming. No conclusions are drawn.

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Microbiological control in sugar factories. A. WREZEL. *Gaz. Cukr.*, 1960, **62**, 277–280.—Details are given of the scheme adopted at various Polish factories for treatment of flume water and water used for diffusion, and of methods of adding formalin to diffusion juice. Recommendations are made, including chlorination of flume water; adding SO_2 to condenser water used in diffusion to lower the pH to about 7·0 and in order to reduce viscosity and colour, as well as disinfect; and the carrying out of frequent microbiological tests.

* * *

Deionization of sugar solutions by electrodialysis using ion exchange membranes. V. Evaluation of pilot-scale tests. J. BURIÁNEK, D. ŠLECHTOVÁ and O. LISÝ. *Listy Cukr.*, 1960, **76**, 217–223.—Results of tests with a dialyser of 50 pairs of membranes are discussed with the aid of graphs. The electricity required to remove 1 electroequivalent of inorganic salts was found to be 1·05–1·78 amp-hr over 5 cycles at voltages of 95–145. The maximum amount of inorganic salts in 1000 tons of beet was estimated at 80,000 eq. For a degree of deionization of $\alpha = 0{\cdot}5$, the power consumption for 1000 tons of beet per day is 235 kW at a potential difference of 100 V, using 650 sq.m. of cation and 650 sq.m. of anion exchange membrane surface at 35°C. At 70°C the membrane surface requirements would be halved.

[1] *Chem. Listy*, 1923, **23**, 3.

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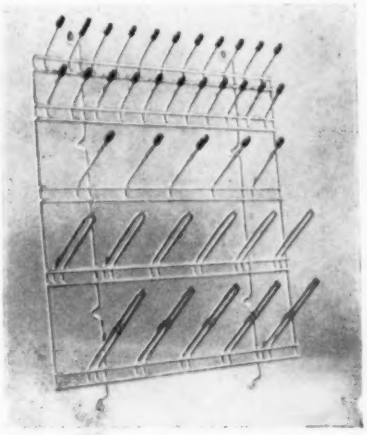

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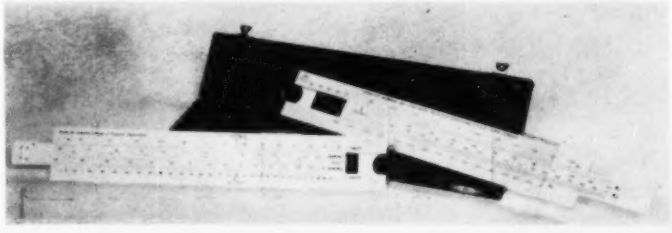

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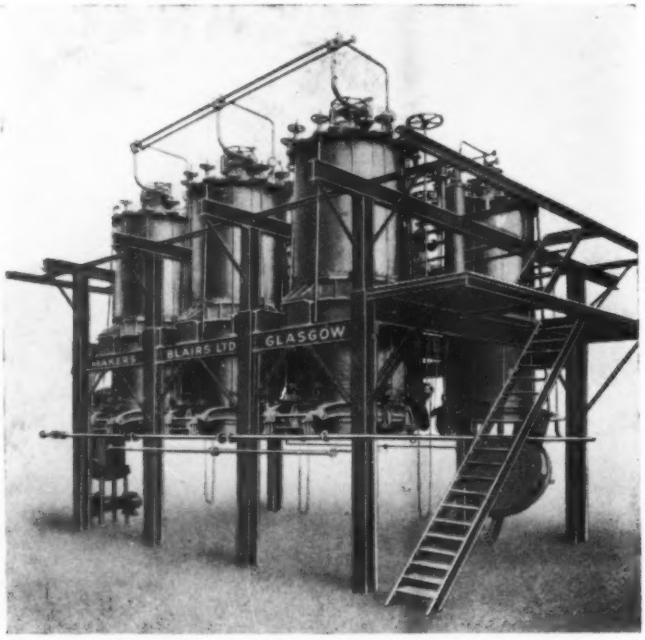

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Year Book and Directory of Indian Sugar Factories, 1959-60. 97 + 17 + 52 + 21 pp; 7¼ × 9½ in. (The Sugar Technologists' Association of India, Nawabganj, Kanpur, U.P., India.) 1960. Price: Rs. 2·00.

This book is in three parts and an appendix, the first and largest being a series of tabulations of final manufacturing results of the Indian sugar factories for the 1959/60 season; they include time and cane accounts, milling results, yields of sugar and molasses, clarification efficiency, etc. The appendix, following the first part, gives the year of establishment, and names of managing agents, technical executives, capital invested and dividend.

Part II is a list of the sugar factories with addresses, machinery suppliers, capacity, milling plant, clarification process and executives' names, a statewise summary of the number of plants being tabulated.

In the third part appears general information on a number of factories, ranging from personnel to agricultural and factory information, etc. The Yearbook forms a very useful complement to the Manual also published by the Association.

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The South African Sugar Year Book 1959-60. 272 pp; 8½ × 10½ in. (The South African Sugar Journal, 321 Smith Street, Durban, Natal, South Africa.) 1960. Price: 10s. 0d.

The new Yearbook, still larger than its predecessor, is equally valuable a source of information on the organizations and companies forming the South African Industry. It follows the familiar pattern, with a series of special articles, four out of eight concerning the development of sugar production in Swaziland. The review and statistical articles again concern the activities of the cane growers, and millers' associations, etc., as well as the S.M.R.I., sugar production, crop and price data up to the 1960 season, etc., and details of the sugar milling enterprises of South Africa and neighbouring countries are again published with amendments, to bring them up to date. Information on manufacturers and suppliers to the sugar industry is provided in the last section of the book.

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Indian Sugar Manual, 1959. R. B. Saxena. viii + 246 pp; 7¼ × 9½ in. (The Sugar Technologists' Association of India, Nawabganj, Kanpur, U.P., India.) 1960. Price: Rs. 12·00.

This is the 15th edition of the Manual, and is a survey of the sugar situation of the world, but particularly of India. Data quoted are usually up to the 1958/59 season and are consequently rather out-of-date, particularly in the smaller section dealing with countries other than India, where more recent figures are readily available. However, the depth of detail in the Indian survey is so great that it is unlikely that more recent figures would be readily obtainable for the majority of the subjects covered.

Besides the wealth of statistical matter, information is given on the progress of the development and research carried on under the Indian Central Sugarcane Committee, the 2nd five-year Plan Targets for sugar, fiscal measures, technological progress; new projects licensed, by-product utilization, etc. Publication by the S.T.A.I. is a guarantee of the reliability of the publication as an authoritative reference book of the Indian sugar industry.

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Pure Food and Pure Food Legislation. Ed. A. J. Amos. 167 pp; 4¾ × 7 in. (Butterworth & Co. (Publishers) Ltd., 88 Kingsway, London, W.C.2.) 1960. Price: 21s. 0d.

This book is the record of a conference held in London on 21st–23rd September, 1960 in commemoration of the passing by the British Parliament in 1860 of "An Act for Preventing the Adulteration of Articles of Food or Drink"—the first *general* pure food law in the English-speaking world. The Conference was held under the auspices of the Society for Analytical Chemistry, the Food Group of the Society of Chemical Industry, the Association of Public Analysts, the Royal Institute of Chemistry, the Ministries of Agriculture, Fisheries & Food and of Health, the Department of Health for Scotland, and the Ministry of Health & Local Government in Ireland. Papers were presented on the 1860 Act and its influence on the purity of the world's food, the manufacturers' contribution towards pure food for the people, pure food and the Commonwealth, international aspects of pure food legislation, national problems in Canada, Australia and the U.S.A., and the integration of food research. The book is in the size and style of a paperback.

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Triennial Report. 175 pp.; 6½ × 9¼ in. (The Institute of Sugar Technology, Cosamaloapan, Veracruz, Mexico.) 1956–59.

The report covers so large a field, including organization, commercial and experimental developments both in field and factory, that it constitutes a review of the whole industry. Any particular item, thus, is dealt with in a condensed, perhaps too condensed, manner.

Problems of sugar beet analysis. V. PREY. *Zucker*, 1960, **13**, 514–517.—Tests were carried out to determine the effect of adsorption of N compounds by decolorizing ion exchangers on final molasses purities, with a view to increasing sugar yield. Data are tabulated for molasses treated with ion exchangers on the Ca cycle ("Imacti C 12"), on the Na cycle ("Amberlite IR 120") as well as "Asmit 259" neutral decolorizing exchanger, followed by further crystallization. End-molasses purity was reduced by 1–2 units and sucrose yield considerably increased. The time required for crystallization at 80°C of a massecuite obtained from a juice treated with "Asmit" and evaporated at 40°C was one-half to two-thirds that of massecuite from an untreated juice. The total N content was considerably reduced by the resins, while the amino acids content and betaine N content were not affected, indicating that the N loss must be caused by adsorption of higher molecular-weight N compounds. The N compounds isolated from the thin juices were hydrolysed with 6N HCl during 15 hr at 105° and the hydrolysate shown chromatographically to contain 11 amino acids. Examination of the non-N compounds in the hydrolysate showed that lactic acid was present as well as oxalic acid, while there was little levulinic acid present, indicating that hexoses play a minor rôle as carbohydrates. Previous work had indicated that the carbohydrates forming the coloured N compounds were glyceraldehyde, dihydroxyacetone and methyl glyoxal: these, when hydrolysed under the same conditions, yielded lactic acid almost quantitatively. Both trioses and oxaldehyde were detected in sugar caramel by chromatography, while neither lactic acid nor levulinic acid were present in a caramel hydrolysate. Much lactic acid and oxalic acid were present in hydrolysed pectin and galacturonic acid hydrolysates.

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Colouring matter of the sugar cane and sugar beet. R. T. SESHADRI. *Sharkara*, 1960, **3**, 83–89.—The colouring substances of cane and beet and their chemical composition are discussed.

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Automatic dosing. A. J. VAN DUUREN. *Chem. Weekbl.*, 1960, **56**, 20–21; through *S.I.A.*, 1960, **22**, Abs. 906.—Beet weighing and the addition of lead acetate solution for defecation are made into a single automatic operation by the use of a balance with unequal arms in the ratio of 1:6·835. An amount of pulped beet of about 25 to 30 g is placed in a flask on the pan of the longer arm. A stainless steel beaker on the other pan is then filled with the proportionately correct amount of lead acetate solution (from an overhead constant level reservoir) on pressing a button which operates a magnetic stopcock. When the correct dose has been added the movement of the pan interrupts a light beam to a photocell, and the stopcock is closed. The lead acetate solution is then added to the beet sample. The subsequent taking of an aliquot for analysis thus always gives the desired proportions. The weighing takes only about 20 sec and saves the work of one assistant in the routine laboratory. The method is more accurate than hand operation.

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Formamide as an eluting agent for sugars. S. B. MISRA. *J. Sci. Ind. Res.*, 1959, **18C**, 155; through *S.I.A.*, 1960, **22**, Abs. 911.—Sugar spots developed on a paper chromatogram with *n*-butanol—acetic acid—water solvent and sprayed with aniline hydrogen phthalate were eluted with formamide and the optical densities of the eluates were measured in a photoelectric colorimeter. The intensity of the colours eluted for one hour were found to be directly proportional to the concentration of the sugars. Elution with acetic acid, made for comparison, were found to require 24 hr to complete, and some additional artefact colour also appeared.

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Determination of micro-organisms in sugar products by the millipore method. H. E. HALDEN, D. D. LEETHEM and F. G. EIS. *J. Amer. Soc. Sugar Beet Tech.*, 1960, **11**, 137–142.—Comparative tests were carried out by the Spreckels Sugar Co. on enumeration of yeasts in liquid sugars by the filter membrane method and that of the American Bottlers of Carbonated Beverages (ABCB method). The former technique has not been generally adopted because of divergence of results from those obtained by the latter method. Two porosities of filter membranes were used: 0·45μ and 0·80μ. Mycophil broth of low pH was used in both methods, and an osmophilic broth for the filter membrane method alone. Sterile liquid sugars were inoculated with pure yeast cultures incubated during 3 days at 31–33°C. No significant difference between the results using the 0·45μ and 0·80μ membranes were found when the same medium was used, although the organisms were better defined on the 0·80μ membrane, which also allowed faster filtration. Two yeasts grew equally well on either of the nutrient broths, results being comparable for both methods and all broths, except in one test where poorer results were obtained with the ABCB method. A third yeast showed a definite preference for mycophil broth (low sugar content) and its growth may possibly be inhibited with the ABCB method, at least at high counts, and is definitely inhibited on osmophilic broth (40% sugars). For evaluation of the different growth requirements of yeasts found in sugar products, it may

become necessary to differentiate between those showing optimum growth in low sugar solutions and those preferring higher sugar concentration. The membrane filter method would seem to be somewhat better than the ABCB method.

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Some effects of virus yellows on sugar beet processing quality. A. E. GOODBAN, A. I. MORGAN, R. TERANISHI, H. G. WALKER and R. M. MCCREADY. *J. Amer. Soc. Sugar Beet Tech.*, 1960, **11**, 164–167.—Beets inoculated with virus yellows were compared with healthy beet by means of tests in which the beets were processed in a laboratory processing plant after 45 days' storage at 1°C. They were extracted at 70°C during 45 min in an Olsen diffuser, at a draught of 135%. The raw juice was limed and carbonatated in a model Dorr carbonatation tank at 80°C during 23 min with addition of 2% lime on beet and a recycle ratio of 7:1. Final 1st carbonatation alkalinity was 0·078 and 0·111% CaO for the control and 0·089 amd 0·110% CaO for the infected beets. The sedimentation and filtration rates were measured and a 1st carbonatation juice filtrate sample subjected to 2nd carbonatation in which the filtrate was boiled, gassed during 3 min with CO_2 and boiled during 5 min to remove excess CO_2, giving a 2nd carbonatation juice of 0·014% CaO/100Bx. The juice was filtered and analysed (0·012% control) for sucrose, RDS, total N, colour and lime salts. Purities were 95·2% (inoculated) and 95·4% (control). The difference in colour was considerable, although it is not known in this case how much of the colour would be carried through to white sugar. The greatest differences lay in the settling and filtration rates and in the total N. Respective values for control and inoculated beet were: 17 and 107 lb/sq.ft./hr settling and filtration rates compared with 14 and 32 lb/sq.ft./hr, and 435 mg total N per litre at 10% RDS compared with 560 mg N/litre.

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Methods of determining the coefficient of saturation. I. E. SADOVYI. *Sakhar. Prom.*, 1960, (10), 19–20.—By adding 10 g of crystal sugar to 100 g of 2nd product molasses at normal Brix, the molasses may be brought to saturation within 8–9 hours; in its absence, crystallization of the excess sugar from a supersaturated molasses sample may take 3–4 days. After refractometric Brix and pol determination, the coefficient of saturation is calculated as a function of the ratio of non-sugars to water as suggested by WIKLUND.

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Surface tension of water-alcohol-sugar solutions. S. E. KHARIN and V. I. TSELINSKAYA. *Izvest. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1960, (4), 148–153.—Tests were carried out to determine the surface tension of a water-ethanol-sucrose system at ethanol and sucrose concentrations of 1–45 weight % at 20°C and concentrations of 3–20 weight % at —5 to 40°C. The results agree closely with those of HOFFMANN *et al*[1]. Addition of sucrose did not increase the surface tension of an aqueous alcohol solution. The activity coefficients of the ethanol calculated with a given formula at various concentrations agreed closely with determined values, as did the surface tension. Tables of calculated and determined surface tension data of the three-component system as a function of composition and temperature show a maximum deviation of ±0·8 dyne-cm.

* * *

Device for determination of the volumetric concentration of crystals in a massecuite. V. D. POPOV and I. G. BAZHAL. *Izvest. Vysshikh Ucheb. Zaved., Pishch. Prom.* 1960, (4), 154–157.—Data are tabulated of massecuite and intercrystalline molasses conductivity and crystal content as determined using the device previously described[2]. Accuracy was to within 5%; this rather low accuracy is attributed to the poor arrangements made for the test and may be considerably improved.

* * *

Hydrolysis of certain carbohydrates by carbon dioxide under pressure. L. M. AGEEV. *Trudy Leningrad. Tekhnol. Inst. Pishch. Prom.*, 1958, **14**, 193–197.—Sucrose, inulin and starch were hydrolysed by CO_2 at pressures of 6–8 atm., 20 g of sucrose being diluted, heated to 85–100°C and hydrolysed during 1–3 hr; the CO_2 was boiled off and the inverted sucrose content determined iodometrically by titration with thiosulphate. Besides tabulated results, u.v. adsorption spectrum graphs are presented of the sugar solution after hydrolysis. During the hydrolysis the hydrolysis products are further decomposed, to a greater extent as the temperature, pressure and time increase. When certain free acids or salts are added they accelerate hydrolysis and decomposition of the hydrolysis products, leading to the formation of hydroxymethyl furfural as well as sugar anhydrides.

* * *

Analysis of beet marc in connexion with pressing quality of exhausted pulp. R. CAROLAN. *Irish Sugar Co. Ltd. Research Lab. Rpt.*, 1960, (44), 13 pp.—In these tests, 50 g of unpressed pulp was blended with 200 g of water in an "Atomix" during 4 min and heated to 70°C. After leaching with water at 70°C until free of sugar (α-naphthol test), the cellulose, lignin and pectic substances were determined. Duplicates were dried at 70–75°C and 100–110°C. For cellulose determination, 0·5 g marc was boiled gently with 25 ml of a mixture of acetic acid, nitric acid and water (650:80:150, v/v/v). After filtering, the cellulose was washed with alcohol, hot benzene and alcohol, and cold ether, and dried at 105–110°C; it was then cooled over H_2SO_4, weighed, ashed, and re-weighed, the difference in weight being the cellulose. Lignin was determined by digesting 1 g of marc at 40°C for ½–2 days with 40 ml of a 1% solution of pepsin in N/10 HCl, filtering, washing and drying at 100°C. The digested material was placed in a beaker containing 30 ml 72% H_2SO_4, stirred, filtered, washed, dried at 100°C, weighed, ashed and re-weighed. Both

[1] *Z. phys. Chem.*, 1957, **11**, (1–2), 56.
[2] *I.S.J.*, 1961, **63**, 22.

cellulose and lignin contents were normal. The pectic substances were determined by neutralizing a 10–50 mg sample, adding 15 ml N HCl to about 100 ml, adding methylated spirit (200 ml), filtering, washing into boiling water, washing and hydrolysing with 0·2 N NaOH. Acetic acid was added, then $CaCl_2$ during stirring. After boiling and filtering, the resultant jelly was filtered and washed, dried at 95–100°C and weighed as calcium pectate (containing about 7% Ca). The results are low in comparison with values in the literature, possibly owing to the high moisture content of Irish pressed pulp, and are not correlated with pulp compressibility.

* * *

The use of narcotics (chloroform) in the determination of sucrose in bagasse. L. R. BLISS. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958 141–145.—Use of heat to kill the cells and so make their walls permeable to sucrose has the ill-effect of causing the solution of non-sucrose which lowers the purity of the hot water extract and leads to errors in polarization. Treatment of the bagasse sample with chloroform vapour under reduced pressure at 46°C permitted extraction with cold water; treatment for 40 min appears adequate for complete extraction.

* * *

Weight and polarization changes of the raw sugars exported to the United Kingdom. J. DUPONT DE R. DE ST. ANTOINE. *Mauritius Sugar Ind. Res. Inst. Tech. Circular*, 1959, (12), 20 pp.—Total monetary losses in sugar exported from Mauritius to the U.K. during the period 1956–1959 have been high as a result of weight and pol loss between shipment and unloading. On 280,997 tons from the 1958/59 crop, the loss was more than Rs. 1¼ million. Details are tabulated for each consignment during the three years mentioned. These reveal average pol changes in bagged sugar of —0·01, —0·03 and —0·08 for 1956/57, 1957/58 and 1958/59 respectively. For bulk sugar, the corresponding pol changes were —0·14, —0·13 and —0·27. (Although shipped in bulk, the sugar is first bagged, then emptied into the holds.) Weight losses for bulk sugar are 0·7% and 0·5% for bagged sugar. Monetary losses average Rs. 2·35 per ton of 96° sugar bagged and Rs. 4·08 per ton of bulk sugar. Tables of the Dilution Indicators for certain factories are also given, and a graph drawn of pol *vs.* moisture content. This shows that the majority of the sugar sampled is located between two lines corresponding to D.I. values of 33·3 and 50·0, i.e. in a zone considered doubtful from the point of view of keeping quality. Some sugars were in a danger zone. The D.I. increased on average from 36·0 in 1956 to 41·2 in 1958. Thus, it is apparent that microbiological deterioration is the major cause of the losses, and a penalty system is recommended based on the D.I. and similar to the system in Australia. It is also suggested that pol determination be made in a constant temperature room at 20°C and more representative samples made available.

Contribution to beet evaluation. M. DRACHOVSKÁ, R. OSVALD and L. SCHMIDT. *Listy Cukr.*, 1960, **76**, 234–237.—Twenty-three different formulae for beet evaluation are reviewed. Comparative tests were carried out to find a suitable means of estimating the sugar content in beet: determination of ash dissolved in the press juice, calculation of the beet "purity", and determination of the quality of raw or thin juice. The most suitable and easy method was found to be the last, using a laboratory juice purification scheme. The determination of ash in the press juice gives values rather lower than the thin/raw juice determination and is particularly unreliable when the organic non-sugars content in the beet is high.

* * *

Process for determination of very small amounts of sugar using a colorimetric comparison analysis. P. GORZANOWSKY and F. E. BARTHOLOMAE. *Zucker*, 1960, **13**, 560–561.—The process is based on the reaction of an α-naphthol solution with sugar in the presence of sulphuric acid. Sensitivity is to within 0·0005% sugar, with an upper limit at 0·030% sugar, after which the colour is too dark; with higher sugar contents the solution should be diluted with sugar-free water and the result multiplied by the degree of dilution. The α-naphthol solution is made up by dissolving 0·5 *g* α-naphthol (analytical reagent grade) in 30–40 ml ethanol and diluting with water to 500 ml. A 2 ml aliquot test solution is mixed with 2 ml of the α-naphthol solution and 5 ml H_2SO_4 added, the mixture agitated during 20 sec, cooled during 40 sec and the colour compared with that of a set of six standard solutions containing 0·005, 0·01, 0·015, 0·020, 0·025 and 0·03% sucrose. For more exact work to 0·001% sucrose 2·2 ml α-naphthol reagent should be used with 5 ml sulphuric acid.

* * *

Solubility of sucrose in the presence of glucose and an electrolyte. J. R. DE LA VEGA and A. PERUJERO. *Mem. XXXII Conf. Asoc. Técn. Azuc. Cuba*, 1958, 89–98.—The sucrose:glucose:KCl:water system studied by KELLY[1] was not considered adequate for a study of molasses formation, since KCl was not the major ionic component. Studies were therefore made on four-component systems in which the electrolyte was $CaCl_2$, K_2SO_4 and KH_2PO_4, and these results are combined with the KCl results. The invariant points were determined and the respective concentrations are presented in tables and in triangular diagram form. The concentration of the electrolyte at the invariant point increased in order of solubility in water, while the sucrose solubility was more strongly reduced by the electrolytes than by glucose. The sucrose concentration at the invariant point divided by its solubility in pure water varied inversely with ionic strength of the electrolyte. The highest concentration of sucrose at an invariant point occurred with K_2SO_4, corresponding to 56·63 purity, compared with 43·4 for KCl, 45·4 for $CaCl_2$ and 52·06 for KH_2PO_4.

[1] *I.S.J.*, 1955, **57**, 386.

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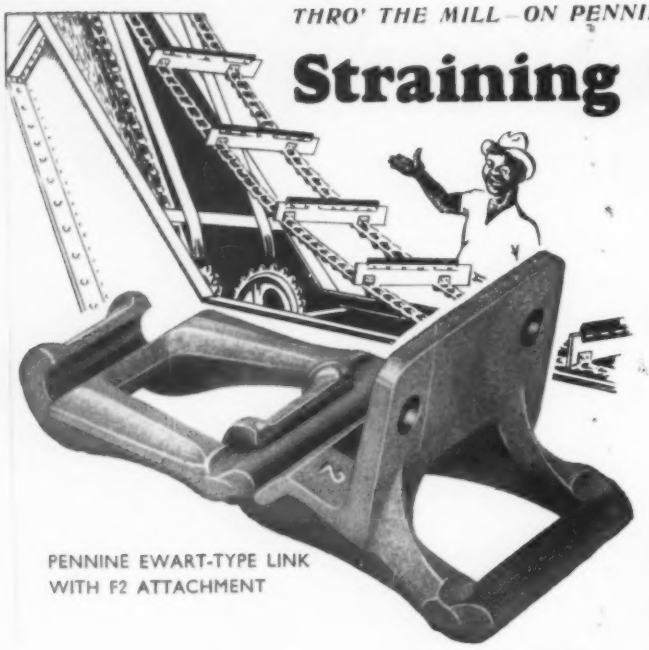

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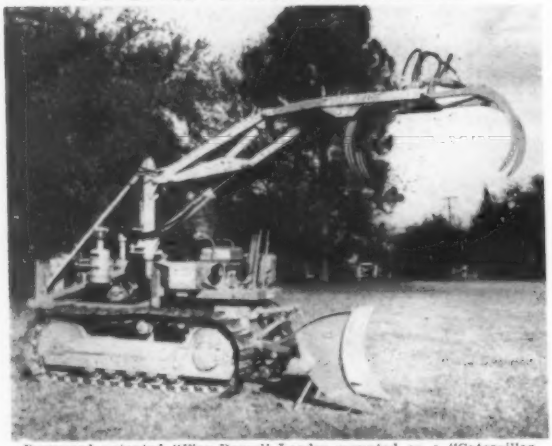

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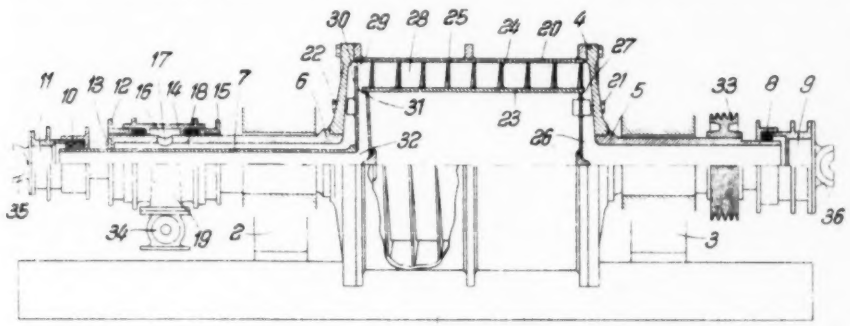
PATENTS

UNITED KINGDOM

Sludge (clarifier mud)-treating centrifuges. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT A.G., of Braunschweig, Germany. **855,359.** 11th February 1958; 30th November 1960.—A centrifuge mounted on bearings 2, 3 carried by base plate 1 includes an outer drum 4 to and from which lead hollow inlet and outlet shafts 5, 6, the latter containing a second



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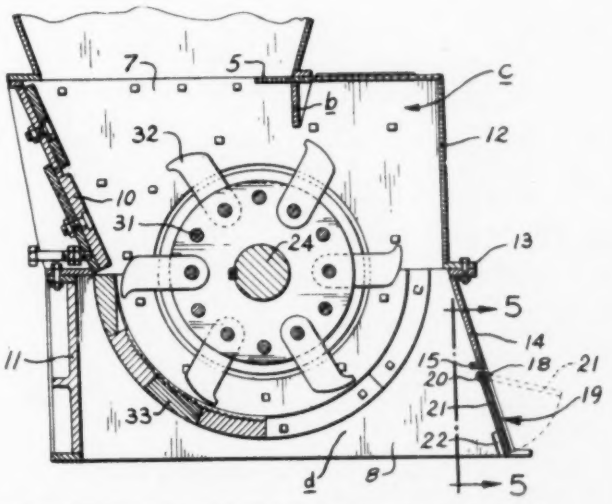
inner hollow shaft 7. Shaft 5 is connected to a feed conduit 9 with packing 8 provided at the joint. The inner outlet shaft 7 is similarly connected to a discharge conduit 11, the joint having packing 10. The outer outlet shaft 6 is closed by stuffing box 12 and sealed from shaft 7 by a jacket 13. Stuffing box 12 closes a casing 14 which surrounds shaft 6 and at the other end is also closed by a stuffing box 15. The casing encloses an annular space 16 communicating through holes 17 with the annular space 18 between the shafts 6, 7. A short discharge pipe 19 for sediment is connected to space 16. The longitudinal part 20 of the centrifuge casing is internally cylindrical and contains an inner drum 23, held by screws 21, 22. Drum 23 has spiral turns 24 welded to its outer surface which may reach almost to the inside surface of cylinder 20 and leaving gaps 25, or which may extend to this inside surface, leaving no gaps. Sludge to be treated passes from the bore of the inlet shaft 5 to the spiral path 28 by way of chamber 26 and space 27. In this spiral the liquid and solid components separate, the latter passing through the annular space 29 to the chamber 30 and so into the annular chamber 18 and thence to the discharge pipe 19 through holes 17 and space 16. The clarified liquid passes through the space 31 to chamber 32 and thence through shaft 7 to the conduit 11. Outflow of clarified liquor and solids is controlled by independent valves 34, 35 while a throttle valve 36 governs the feed of slurry.

* * *

UNITED STATES

Shredding machines. L. FREEMAN, assr. GRUENDLER CRUSHER & PULVERIZER CO., of St. Louis, Mo., U.S.A. **2,954,937.** 26th April 1957; 4th October 1960.—Cane enters a hopper which at its lower end is bolted to the horizontal top wall 5 of an open-bottomed shredder housing, in alignment with an opening 7 in this top wall. The housing has side walls 8, a forwardly inclined upper back wall 10 and a vertical lower back wall 11. The vertical upper front wall 12 ends in a flange 13 to which a sloping front wall 14 is bolted. A flap 21 is hinged to flange 15 on the wall 14 by means of a pivot pin 18 and hinges 20. It rests under its own weight against stops 22 at the bottom of closure 19. Driven shaft 24, suitably journalled in the side plates, carries a series of spaced discs 30, carrying the rods 31. These rods secure a series of spaced hammers 32 which co-operate with stationary cutter bars 33 to shred cane fed through the hopper. The shredded cane passes through the bottom opening *d* to a conveyor which delivers it to the cane mill. Any shredded cane attached to the hammers which is flung up to the chamber *c* is prevented by baffle *b*, hanging beneath the top wall 5, from mixing with incoming whole cane, and falls out through opening *d*. If the conveyor does not move the shredded cane away quickly enough, it will tend to build up inside the housing and eventually lift the flap 21, discharging through the opening 19 onto the conveyor.



Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

UNITED KINGDOM SUGAR IMPORTS AND EXPORTS[1]

IMPORTS

	1960	1959	1938	1913
Refined	*Tons*	*Tons*	*Tons*	*Tons*
France	3,988	2,434	—	26,570
Czechoslovakia	15,239	23,601	16,123	§198,064
Holland	2,060	36	3,489	178,567
Belgium	2,831	1,917	1,255	49,764
Germany(West)	5,521	2,811	296	465,453
Poland	14,849	36,429	494	—
Ireland	13,075	12,665	—	—
U.S.A.	15	19	14,720	385
Canada	3	2	9	—
Indonesia	—	—	358	—
Kenya	—	—	100	—
Uganda	—	—	200	—
Others	*20,823	‡31,960	76	3,742
	78,404	111,874	37,120	922,545
Raws—Beet				
Poland	31,044	—	16,798	—
Germany	—	—	8,245	472,026
Czechoslovakia	1,330	—	1,330	§160,858
Holland	—	—	6,555	11,208
Denmark	—	—	20,925	—
Belgium	865	—	1,130	2,466
France	—	—	—	18
Other Europe	—	—	—	36,154
Total Beet	33,239	—	55,983	682,730
Raws—Cane				
Cuba	177,373	332,844	601,212	224,227
Dominican Rep.	309,963	255,297	271,345	9,412
Peru	48,613	54,601	61,753	27,487
Indonesia	—	—	143,496	99
Brazil	15,030	119,059	—	5,133
Venezuela	—	—	760	—
Mozambique	—	—	1,150	—
Mexico	—	9,464	—	4,134
Haiti	—	—	18,534	—
Dutch Guiana	—	—	529	4,606
India	1	1	—	3,850
U.S.A.	—	—	15,715	—
Mauritius	324,031	376,160	282,244	20,075
B.W.I.	514,251	533,029	174,626	47.736
Br. Guiana	178,479	168,111	54,891	
South Africa	177,680	198,758	214,566	—
Australia	337,013	269,806	380,579	—
Fiji	84,704	104,958	76,753	—
Kenya	—	—	4,425	—
Uganda	—	—	5,693	—
Tanganyika	—	—	4,540	—
Others	†8,235	—	64	17,226
Total Cane	2,175,373	2,422,088	2,312,875	363,985
Total Raws	2,208,612	2,422,088	2,368,858	1,046,715

EXPORTS

	1960	1959	1938	1913
	Tons	*Tons*	*Tons*	*Tons*
Germany	4,788	4,698	1,288	
Holland	10,202	19,203	2,422	3,389
Belgium	285	4,521	669	
Denmark	15	6	537	4,407
Norway	54,442	38,373	56,641	
Finland	1	3	52,831	
Sweden	67	89	—	
Portugal	1	1	—	
Austria	—	—	—	
Switzerland	31,325	29,506	42,476	
France	504	531	307	
Greece	9	653	18,248	
Turkey	740	986	6,876	
Italy	1,285	946	2,323	
Yugoslavia	3	78	—	
Estonia	—	—	22,162	
Iceland	536	16	4,930	
Faroe Islands	—	—	—	
Ireland	94	92	32,414	
Egypt	100	1	887	
Sudan	8,269	—	—	
Iraq	71,959	74,888	3,118	
Iran	641	394	237	
Jordan	7	—	—	
Israel	526	431	492	
Saudi Arabia	14,001	30,202	149	
Muscat & Oman	7	77	—	
Syria	—	—	63	
Lebanon	1,408	2,239		
Morocco	285	75	1,028	
Libya	311	1,155	—	
Tunis	14,198	23,453	—	
Ethiopia	54	50	—	
Uruguay	—	—	44,746	
U.S.A.	2,962	443	1,331	
Other Foreign Countries	9,464	11,812	6,411	
Total Foreign	228,489	244,922	302,586	?
Channel Islands	‖	‖	3,066	138
Gibraltar	2,700	2,766	1,058	
Malta/Gozo	2,677	3,222	5,538	
Cyprus	10,839	11,903	3,213	
Aden	1,530	855	1,515	
Malaya/Singapore	76,570	76,400	25,369	
Hong Kong	1	1	—	
South Africa	57	84	—	
Ceylon	893	842	100	
India	22	7	195	
Pakistan	43	25	21	
Falkland Islands	112	142	101	2,720
Canada	10	11	7,417	
Brit. West Africa	106,450	100,931	—	
Bahrein, Kuwait, etc.	18,173	33,443	—	
Bermuda	736	416	1,723	
B.W.I./Bahamas	5,863	6,788	4,873	
North Borneo	—	—	—	
New Zealand	11	—	—	
Brit. East Africa	16,063	47,337	—	
Somaliland Prot.	9,000	8,500	—	
Other British Countries	1,788	906	5,286	
Total British	253,538	294,579	59,475	?
Grand Total	482,027	539,501	362,061	23,270
Total Re-exports, Raw and Refined Sugar			808	4,648

[1] C. Czarnikow Ltd., *Sugar Review*, 1961, (494), 37.

* Including 9690 tons from Cuba, 4000 tons from Mexico, 2488 tons from East Germany, 2154 tons from Paraguay, 1500 tons from Peru and 984 tons from the Argentine.

† From the Argentine.

‡ Including 18850 tons from Mexico, 7765 tons from Germany East, 3058 tons from the Dominican Republic and 2283 tons from China.

§ Austria/Hungary.

‖ Shipments of sugar to Channel Islands no longer counted as an export.

ICUMSA

The following list of Referees and Associate Referees has been proposed by National Committees to serve at the 13th Session of ICUMSA in Berlin, August 26th—September 1st, 1962:—

SUBJECT

1. Constitution and By-Laws. REFEREE: H. C. S. de Whalley (U.K.). ASSOCIATE REFEREES: A. Carruthers (U.K.), T. R. Gillett (U.S.A.), J. C. González Maíz (Cuba), N. J. Loft (Denmark), R. A. McGinnis (U.S.A.), G. R. Maybee (Canada), N. C. Varma (India).

2. Weighing, Taring and Sampling of Sugars. REFEREE: A. E. Tate (U.K.). ASSOCIATE REFEREES: G. R. Athavale (India), H. G. Gerstner (U.S.A.), D. V. Karmarkar (India), R. W. Rutledge (Australia), G. Vlases, Jnr. (U.S.A.), D. P. Smith (Australia).

3. Ash. REFEREE: K. Douwes Dekker (S. Africa). ASSOCIATE REFEREES: J. Buriánek (Czechoslovakia), D. F. Charles (U.S.A.), C. A. Fort (U.S.A.), J. Henry (Belgium), A. Lemaitre (France), N. A. Ramaiah (India), F. Schneider (Germany), D. B. Taylor (U.K.), C. Vignes (Mauritius), D. H. Wilson (Australia).

4. Reducing Sugars. REFEREE: Emma J. McDonald (U.S.A.). ASSOCIATE REFEREES: T. Ando (Japan), A. Bellanger (Canada), Wei Chen (Taiwan), J. H. Defrates (U.K.), D. H. Foster (Australia), A. L. Hopewell (Australia), D. H. Horner (Canada), A. A. Jackson (U.S.A.), G. R. Maybee (Canada), W. Schiebel (Germany), F. Schneider (Germany), S. Mukherji (India), R. de Vletter (Holland), D. H. Wilson (Australia).

5. Bone Charcoal and Other Adsorbents. REFEREE: F. G. Carpenter (U.S.A.). ASSOCIATE REFEREES: R. S. Bowman (U.S.A.), E. W. P. Cuneen (Australia), R. S. Dubey (India), L. F. Gleysteen (U.S.A.), C. B. Mountfort (Australia), N. Pennington (U.S.A.), W. L. Reed (U.S.A.), F. W. Schwer (U.S.A.), H. M. Thompson (U.K.), R. Vandewijer (Belgium).

6. Sucrose in Molasses (by chemical methods). REFEREE: W. W. Binkley (U.S.A.). ASSOCIATE REFEREES: C. H. Allen (U.K.), D. H. Foster (Australia), A. A. Jackson (U.S.A.), J. G. Maltby (U.K.), S. Mukherji (India), J. B. Peterson (U.S.A.), J. M. Saha (India), S. Stachenko (Canada), R. Vandewijer (Belgium), D. H. Wilson (Australia).

7. Refractive Index. REFEREE: K. Rosenhauer (Germany). ASSOCIATE REFEREES: A. Emmerich (Germany), A. Hagan (U.S.A.), S. Hill (U.K.), A. L. Hopewell (Australia), J. L. Martin (U.S.A.), W. M. Vaidya (India).

8. Quartz Control Plates. REFEREE: R. Bünnagel (Germany), ASSOCIATE REFEREES: A. L. Hopewell (Australia), J. W. Gates (U.K.), F. P. Phelps (U.S.A.), A. Ran (India).

9. Refining Qualities of Beet Sugars. REFEREE: P. Devillers (France). ASSOCIATE REFEREES: C. H. Allen (U.K.), N. Brinton (U.K.), E. Schulze (Germany), R. Vandewijer (Belgium).

10. Refining Qualities of Cane Sugars. REFEREE: C. W. Davis (Australia). ASSOCIATE REFEREES: J. B. Alexander (South Africa), C. H. Allen (U.K.), A. M. Hertzberg (Australia), P. F. Meads (U.S.A.), J. Reiche (U.S.A.), S. Staub (Mauritius), —. Vaidyanathan (India), R. Vandewijer (Belgium).

11. Specifications and Tolerance for Pure Sucrose and Reagents. REFEREE: J. Henry (Belgium). ASSOCIATE REFEREES: C. Erb (U.S.A.), D. V. Karmarkar (India), R. E. Runeckles (U.K.).

12. Crystallizing Qualities of Sugar Solutions. REFEREE: A. VanHook (U.S.A.). ASSOCIATE REFEREES: E. Bjerager (Denmark), L. Cavallaro (Italy), D. H. Foster (Australia), E. C. Gillett (U.S.A.), S. N. Gundu Rao (India), M. Kamoda (Japan), G. Mantovani (Italy), A. McAuley (Australia), J. H. Payne (Hawaii), H. E. C. Powers (U.K.), N. A. Ramaiah (India), B. M. Smythe (Australia).

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14. Sucrose in All Sugar Products (by Polarimeter). REFEREE: J. Dubourg (France). ASSOCIATE REFEREES: K. S. G. Doss (India), B. B. Gairola (India), J. Gyorkos (Canada), A. L. Hopewell (Australia), J. R. Johnson (U.S.A.), Emma J. McDonald (U.S.A.), T. J. Mitchell (U.K.), P. Naffa (France), N. A. Ramaiah (India), R. Salani (Italy), J. L. du Toit (South Africa), D. H. Wilson (Australia).

15. Dry Substance in Sugar Products. REFEREE: L. Cavallaro (Italy). ASSOCIATE REFEREES: D. V. Karmarkar (India), G. Mantovani (Italy), G.R. Maybee (Canada), G. R. McConnell (Canada), F. de Miguel (Cuba), O. M. Nelson (U.S.A.), S. C. Sen (India), R. J. Smith (U.S.A.), J. Dupont de R. de St. Antoine (Mauritius), E. C. Tubb (U.K.).

16. pH. REFEREE: D. Gross (U.K.). ASSOCIATE REFEREES: K. S. G. Doss (India), A. Emmerich (Germany), R. S. Gaddie (U.S.A.), W. D. Heath (U.S.A.), D. H. Horner (Canada), D. S. Murray (U.K.), N. A. Ramaiah (India).

17. Refined Sugar Constituents other than Sucrose, Invert, Ash, Water and Colour. REFEREE: G. P. Meade (U.S.A.). ASSOCIATE REFEREES: J. B. Alexander (South Africa), E. J. Culp (U.S.A.), D. Gross (U.K.), D. Hibbert (U.K.), J. R. Johnson (U.S.A.), L. Langlois (Canada), G. R. Maybee (Canada), R. I. Nicholson (Australia), S. Stachenko (Canada), F. T. Tsai (Taiwan).

18. Laboratory Apparatus. REFEREE: J. Pucherna (Czechoslovakia). ASSOCIATE REFEREES: N. J. Loft (Denmark), W. Schiebel (Germany), G. E. W. Sexton (U.K.), J. P. Shukla (India).

19. Viscosity and Surface Tension. REFEREE: H. I. Waterman (Holland). ASSOCIATE REFEREES: A. Emmerich (Germany), S. C. Gupta (India), J. H. Payne (Hawaii), N. A. Ramaiah (India), G. A. Simpson (U.K.), A. VanHook (U.S.A.), J. R. de la Vega (Cuba).

20. 100°S Point of Sugar Scale and Automatic Polarimetry. REFEREE: F. Schneider (Germany). ASSOCIATE REFEREES: W. O. Bernhardt (U.S.A.), R. Bünnagel (Germany), A. L. Hopewell (Australia), R. J. Mesley (U.K.), J. F. T. Oldfield (U.K.), R. de Vletter (Holland), A. Wexler (U.S.A.).

21. Polarization of Raw Sugar. REFEREE: R. W. Rutledge (Australia). ASSOCIATE REFEREES: W. W. Binkley (U.S.A.), E. J. Culp (U.S.A.), C. Forn (Cuba), G. R. McConnell (Canada), A. L. Hopewell (Australia), R. Leclezio (Mauritius), P. F. Meads (U.S.A.), R. J. Mesley (U.K.), R. de Roos (South Africa), G. E. Waring (Canada).

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25. Inorganic Non-Sugars. REFEREE: R. Saunier (France). ASSOCIATE REFEREES: P. Honig (U.S.A.), A. Lemaitre (France), G. Mantovani (Italy), W. Marcy (U.S.A.), G. R. Maybee (Canada), S. C. Sen (India), S. Stachenko (Canada), E. H. Steiner (U.K.), M. L. A. Verhaart (Holland), A. S. Wendt (Canada).

26. Starch Hydrolysis Products (all constituents and properties). REFEREE: W. Kempf (Germany). ASSOCIATE REFEREES: D. P. Langlois (U.S.A.), A. M. Maiden (U.K.), G. R. Maybee (Canada), J. P. Shukla (India), R. J. Smith (U.S.A.).

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28. Sugars in Sugar Cane. REFEREE: L. F. Martin (U.S.A.). ASSOCIATE REFEREES: P. Honig (U.S.A.), J. H. Payne (Hawaii), S. C. Sen (India).

29. Microbiological Tests. REFEREE: R. Weidenhagen (Germany). ASSOCIATE REFEREES: E. Andersen (Denmark), J. Bruijn (South Africa), P. Devillers (France), H. P. Hofmann-Walbeck (Germany), Helen Lynch (U.S.A.), A. Castillo Mujica (Cuba), W. L. Owen (U.S.A.), A. B. Rizzuto (U.S.A.), M. Pamela Scarr (U.K.), I. R. Sherwood (Australia), J. P. Shukla (India), D. E. Webster (Canada).

BREVITIES

Bagasse paper and board for India[1].—Credit of 20 million rupees (£1,500,000) loaned by the Export-Import Bank to Seshasayee Paper and Board Co. Ltd. of Madras, India, will help finance the contruction of a paper and board mill at Erode. Total cost is 60 million rupees (£4,500,000). The paper mill will use both bamboo and bagasse as raw materials in its processes, both being obtained from local sources. The Seshasayee firm is affiliated with Parsons & Whittemore Inc., and an estimated $7 million of the total cost will go to purchase U.S. equipment and technical services. Plant output will include printing, writing and wrapping papers.

Stock Exchange Quotations

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London Stocks (*at 16th February*, 1961)	
Anglo-Ceylon (5s)	16/-
Antigua Sugar Factory (£1)	11/3
Booker Bros. (10s)	30/6
British Sugar Corp. Ltd. (£1)	23/6
Caroni Ord. (2s)	4/-
Caroni 6% Cum. Pref. (£1)	14/6
Distillers Co. Ltd. (10s units)	32/9
Gledhow Chaka's Kraal (£1)	43/-
Hulett & Sons (£1)	64/-
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	25/-
Manbré & Garton Ltd. (10s)	64/3
Reynolds Bros. (£1)	41/-
St. Kitts (London) Ltd. (£1)	19/-
Ste. Madeleine (Ord.) (£1)	27/6
Sena Sugar Estates Ltd. (10s)	12/9
Tate & Lyle Ltd. (£1)	50/-
Tate & Lyle Investments Ltd. (5s)	14/9
Trinidad Sugar (5s stock units)	42/3
United Molasses (10s stock units)	38/6
West Indies Sugar Co. Ltd. (£1)	19/-

CLOSING MIDDLE

New York Stocks (*at 15th February*, 1961)	$
American Crystal ($10)	42
Amer. Sugar Ref. Co. ($100)	33¾
Central Aguirre ($5)	23⅞
Cuban American ($10)	17⅝
Great Western Sugar Co.	33¾
South P.R. Sugar Co.	21½
United Fruit Co.	21½

The late Dr. O. W. Willcox.—Dr. O. W. WILLCOX, Technical Editor of *Sugar y Azúcar* since 1924, died in December at the age of 90. He was the author of many papers concerning agriculture and agrobiology.

* * *

New factory and refinery for Florida[2].—The U.S. Sugar Corporation has approved construction plans for a new raw sugar factory near Bryant, Florida. It has also entered into an agreement with Savannah Sugar Refining Corporation to build a refining facility near the raw sugar plant. The raw factory will have a capacity of 5000 tons of cane per day and will be ready for operation by 1st October 1962. Costs were not disclosed.

* * *

Australian 1960 sugar cane crop.[3]—The last of Queensland's sugar mills has now finished crushing, the total crop being 8,686,641 tons of cane compared with 8,427,731 tons in the previous season. The sugar content of the cane is said to be the best for many years and sugar production is expected to be about 8½% higher than last year.

* * *

The late C. H. O'Brien.—The death occurred in November of Mr. C. H. O'Brien, a distinguished member of the Australian sugar industry. He was 82. In 1901 he was one of the first technologists appointed to the newly-formed Bureau of Sugar Experiment Stations, but he left in 1903 to become Chief Chemist of the Fiji Sugar Co. On his return to Australia in 1905 he was appointed Supervising Chemist to Central Mills and subsequently was Chief Chemist at Mulgrave and at Mossman mills. From 1915 to 1924 he served as the first technical member of the Central Cane Prices Board, in 1922 travelling to South Africa at the invitation of its sugar industry to report on its organization. After serving with the A.S.P.A. as a technologist from 1930, he was appointed Editor of the *Australian Sugar Journal* in 1935, retaining that position until 1950 when he retired, maintaining his connexion with the A.S.P.A., however, as a technical adviser until 1954. In this period he wrote a history of the Australian sugar industry.

* * *

The late H. I. Waterman.—The death of Prof. Dr. Ir. H. I. WATERMAN occurred last month at his home in Delft, Holland. Prof. WATERMAN taught at Delft Technical University for 40 years prior to his retirement in 1959, and was well-known throughout the world not only in the sugar industry but in chemical engineering circles generally. Particularly well-known in the sugar industry was his development of a process for beet juice extraction at low temperature, using SO_2 among other reagents, for destruction of the cell walls and maintenance of sterile conditions. Another speciality was the subject of viscosity and surface tension, and he had recently been re-appointed Referee on Subject 19 for the next Session of ICUMSA, having delivered the Referee's Report on the subject in Washington in 1959.

He will be greatly missed by his friends, collaborators and pupils.

[1] *Ind. Eng. Chem.*, 1961, **53**, (1), 17A.
[2] *Lowry & Co.*, 13th December 1960.
[3] *Queensland Newsletter*, 20th December 1960.

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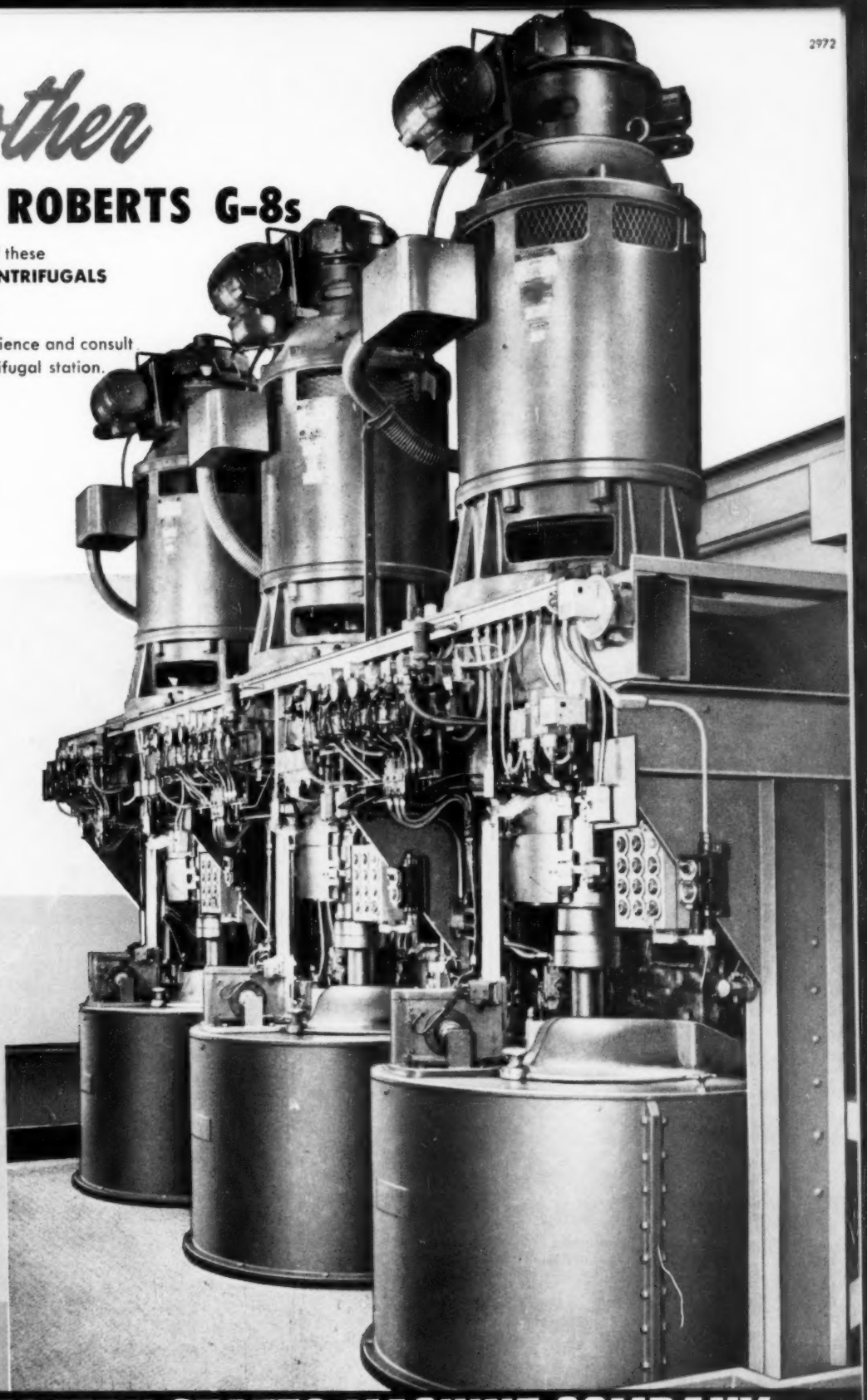

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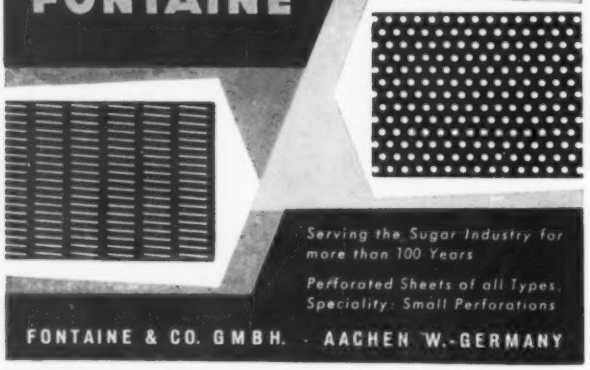

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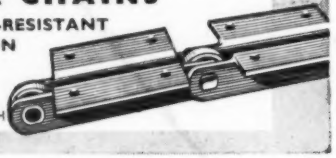

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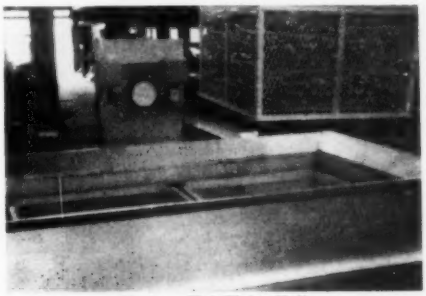

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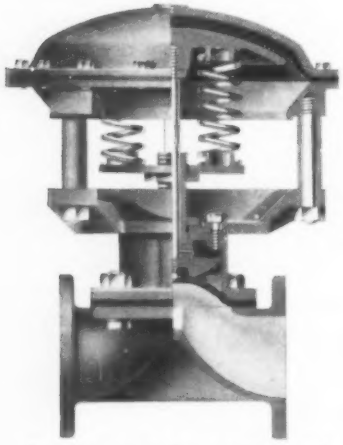

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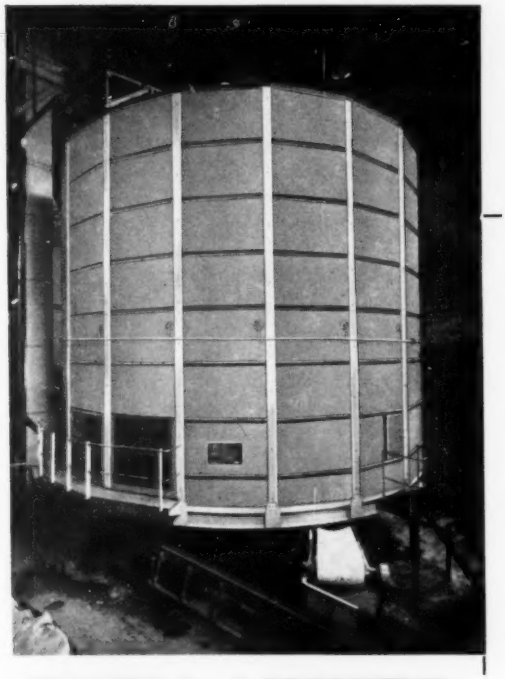

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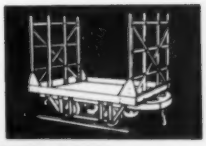

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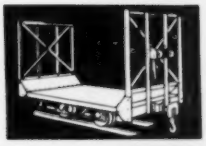

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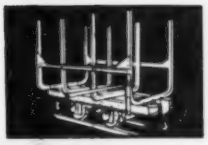

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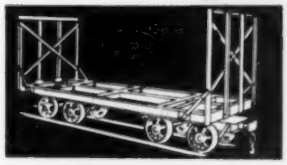

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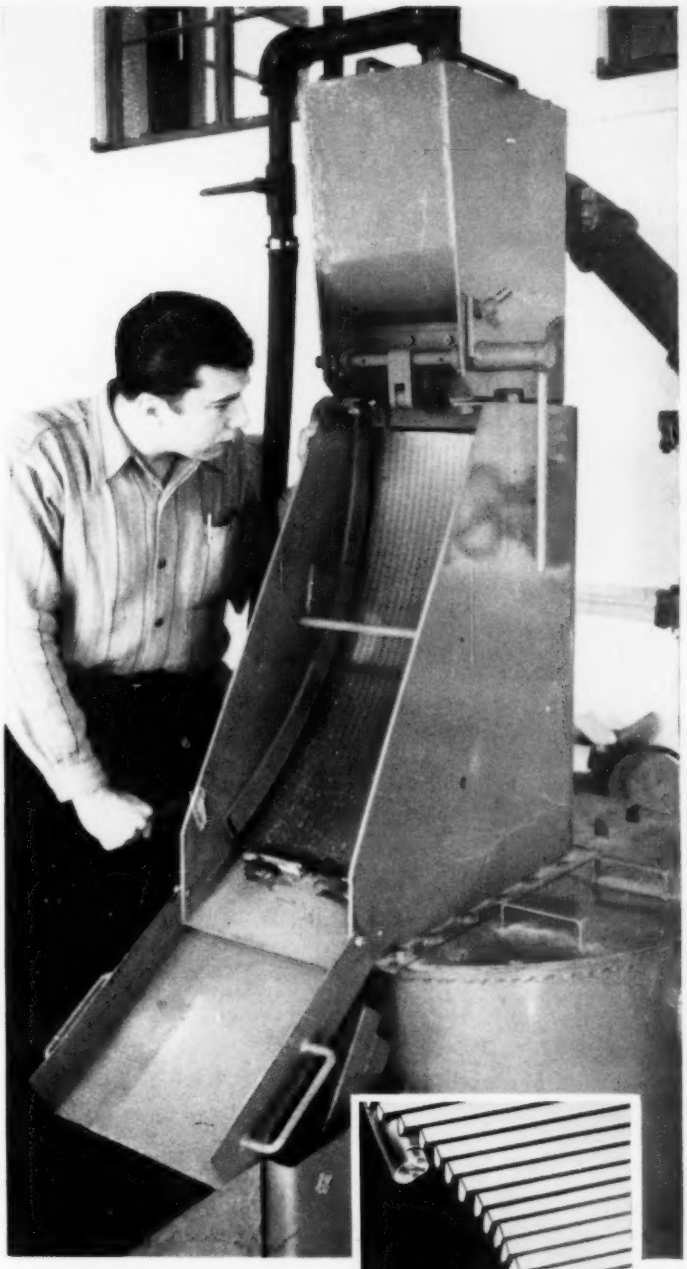

A DSM Screen installation showing simplicity of design and overall compactness.

Closeup showing detail of wedge bar design.

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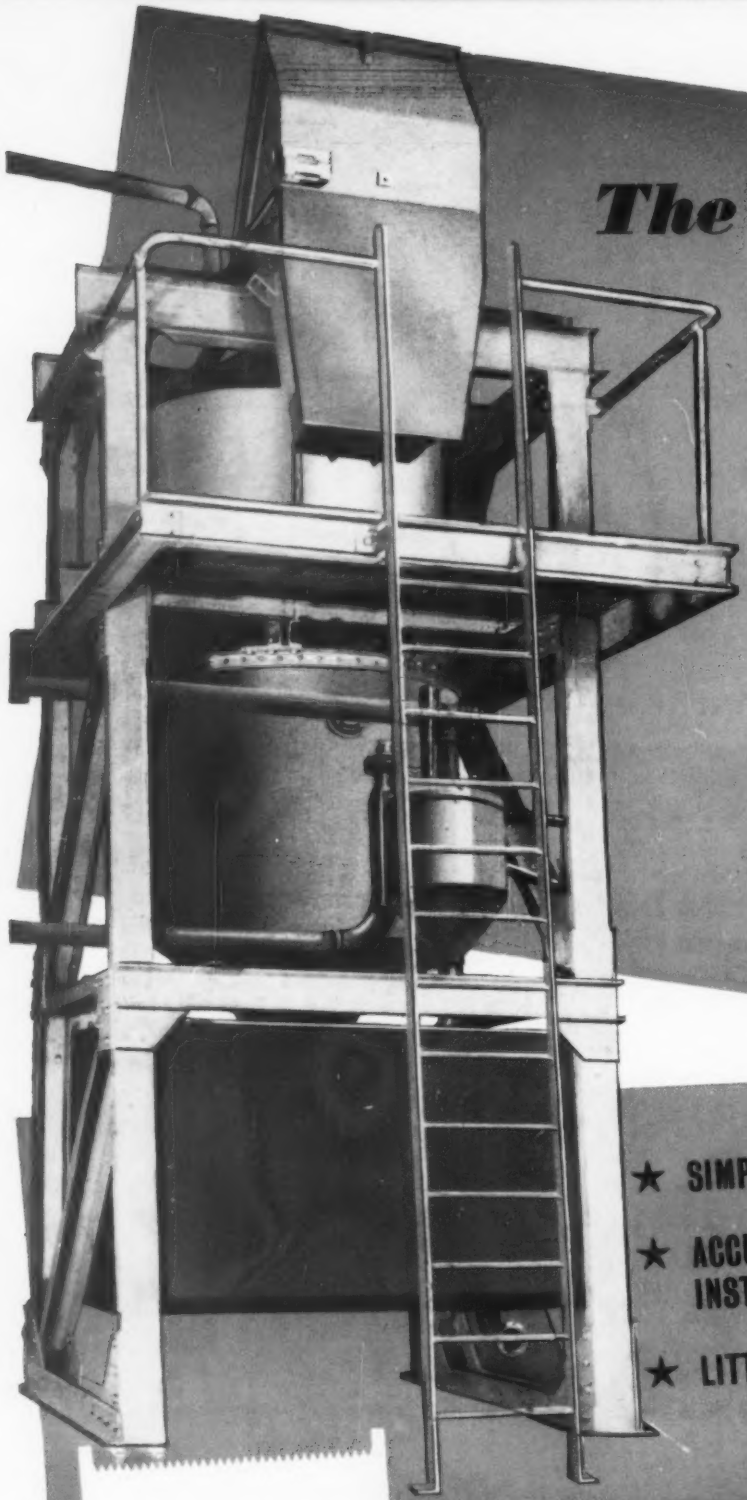

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